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CHINA REPORT

SCIENCE AND TECHNOLOGY

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Tongliao JILIN DAXUE ZIRAN KEXUE XUEBAO [ACTA SCIENTIARUM NATURALIUM UNIVERSITATIS JILINENSIS] in Chinese No 3, 30 Aug 79

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SEISMIC LIQUEFACTION MACROMECHANISM, SEISMIC DAMAGE STUDIED

Beijing GONGCHENG KANCHA [ENGINEERING SURVEYING] in Chinese No 1, 22 Jan 80 pp 1-6

[Article by Fang Hongqi [2455 7703 3825], Wang Zhongqi [3769 6945 3823], Zao Shudong [6392 2885 2767], Huang Zhenglu [7806 2182 6922] of the Institute of Surveying Techniques of the Chinese Academy of Architectural Sciences: "Macromechanism of Seismic Liquefaction and Effects of Seismic Damage"]

[Text] Abstract

Because there are many uncertain elements in evaluating soil liquefaction, results obtained are not satisfactory. This article explores a new way to judge, explain and analyze the macromechanism of seismic liquefaction and effects of seismic damage by the use of aerial photography. It was discovered that the characteristics of landforms and microlandforms greatly affect the macroloci of liquefaction of the field and the characteristics of seismic damage of the land surface. Using this pattern in combination with a comprehensive evaluation of soil conditions of the field, the possibility of liquefaction can be relatively more accurately estimated and from the point of view of earthquake prevention, this can provide an important basis for planning of the general design of construction, planning, design and selection of a rational planar architectural form. This article also preliminarily explored on a theoretical basis the mechanism of formation of macroloci of seismic liquefaction and their different damaging effects to further prove its relationship with surface seismic damage. The article also provides the foundation for the actual application of this method.

I. Existing Problems in the Evaluation of Seismic Liquefaction

Presently, there are generally speaking the following methods to evaluate seismic soil liquefaction:

1. The method of simplification is used to calculate the cyclic shear stress produced in soil layers. This is equivalent to the random shear stress produced by one earthquake. The empirical relationship is used to obtain the ratio between this cyclic shear stress and the effective pressure of the upper covering (τ_{av}/σ_0) under critical conditions of liquefaction.

2. Reflected surfaces are analyzed and possible seismic shear stress which may occur in natural soil layers is theoretically computed and this is contrasted with the strength of resistance of the soil layers to the shear stress to judge whether liquefaction occurs because of weak strength.

3. Determination is based on various empirical indicators or computational formulas established by contrasting the soil conditions of the field of liquefaction of the earthquake region.

All the above methods contain shortcomings that are difficult to eliminate, such as the following:

1. When liquefaction is being experimentally determined using an indoor triple axis or a table to produce movement, the greatest difficulties are the inability to prepare soil samples which approximate natural structural characteristics and the control stress situation that approximates the actual effects of earthquakes.

2. In indoor experiments of force, there are too many artificial and hypothetical conditions. For example, the accuracy and the authenticity of representation of equivalent even cycles of shear stress and the number of cycles of equivalent stress used to simulate an earthquake are often doubtful.

3. The greatest error of standard piercing comes from chance elements. This causes a serious lack of authenticity of the number of piercing strikes.

4. Based on the empirical method of judgment of contrasting intensities, calculating only the natural strength of resistance to shear stress is not enough. This is because during seismic liquefaction, the occurrence of the phenomena of spewing sand and water depends upon the boundary conditions of the soil's degree of saturation, water permeability, richness of water and the liquefied layers.

5. All methods of determining liquefaction by empirical contrasts based on actual conditions of historical earthquakes take the occurrence or the nonoccurrence of the phenomena of spewing sand and water from the level field as the macroindicators for determining liquefaction. Yet, in establishing some contrasting computational formulas, only one point in the soil layer is taken as the standard by which to judge whether the conditions of critical stress of the beginning of liquefaction has been reached. Strictly speaking, the two do not possess the same contrasting bases.

6. At present, all methods of determining liquefaction have neglected to take into consideration the effect of partial landforms of the field and the structures of the earth's strata upon liquefaction. This article will show such effects are extremely important.

II. Macroscopic Studies of Seismic Liquefaction

It can be seen from the above summary that the traditional methods and means of studying liquefaction have many obvious shortcomings. The effectiveness

and the accuracy of present methods in predicting the degree of liquefaction in a large field and its damage are worth scrutiny. By studying geological cartography in the field of engineering related to earthquakes in regions of strong seismic activity and by judging and explaining with the aerial photographs, the macroscopic patterns of liquefaction were found. Using these patterns in combination with the method of comprehensive evaluation by conducting tests at the sites, the effectiveness and precision of the evaluation of seismic liquefaction can be greatly elevated.

Aerial photographs of a scale of 1:10,000 taken 3 days after the Tangshan earthquake of July 28, 1976 were used. Since all the scenes of landforms, geomorphology and liquefaction remained unchanged, they are the most accurate recorded images that show seismic damage by earthquakes on a macroscopic scale, and represent microscopic changes in the texture of the soil.

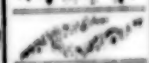
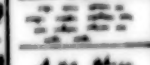
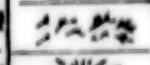
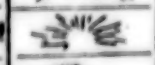
The special function of aerial photography can show the visible differences in images created by landforms and geological materials and thus can effectively increase the ability to differentiate geomorphological characteristics. It can also show the true and entire scene of liquefaction due to seismic damage on the ground surface because of its wide view taken from a high altitude. This type of overall view cannot be seen by man surveying on the ground surface. Therefore, after a strong earthquake, pictures show clearly large scale spewing of water and sand, sliding movements of coasts and banks, tectonic splitting and the forms and patterns of damage to construction on the ground as a whole within a large area. The shades of color and the linear differences shown in the pictures formed by the differences in the degrees of absorption of light can serve as the basis for determining the distribution pattern, the scale and characteristics of geometrical mechanics of liquefaction after an earthquake and their relationship to seismic damage on the ground surface on a macroscopic scale. These characteristics illustrate the pattern of seismic movement in the field of liquefaction. This enables us to predict according to these patterns the possibility of occurrence of liquefaction in future earthquakes and the degree of the effects upon construction facilities on the ground surface.

The different loci of liquefaction of this area shown in the aerial photographs can be divided into the following major types listed in Table 1.

1. Scattered Star Shapes (Photographic plates 1, 2, 3, see centerfold):

The images are characterized by a relatively even distribution of star shaped spots (sandy volcanoes). The size and the density of the spots reflect the difference between the values of seismic coefficients and the duration of the vibrations of level seismic waves. The greater the frequency, dispersion and intensity of the horizontal wave the longer the vibration and the greater the diameter of sand piles that surge up. The density (distance between spewing holes) generally reflects the depth of burial of the stratum of liquefaction and the effective pressure of the top covering. There are three subtypes according to density. When the layer of liquefaction is buried deeply,

Table 1. Macrotypes of Seismic Liquefaction and Their Characteristics

1 液化基型类型	6 亚型	19 液化形迹图式	20 相版号	21 地貌及地形特征	26 地面波动主要方式
2 星散型	7 稀星型		1	22 地形平坦，地貌单一的滨海平原区	27 均匀传播的地表行波
	8 密星型		2		
	9 星云型		3		
3 线型	10 直线型		4	23 地形平坦，地貌单一的河间平原区	28 均匀传播的地面行波，或两个方向的行波相遇，或行波进行中局部受阻
	11 共轭型		5		
	12 弧线型		6		
4 网络型	13 脉络型		7	24 河曲凸岸，水文网密集的低洼河间地区	29 波的反射与聚焦形成驻波
	14 树枝型		8		
	15 放射型		9		
5 旋转型	16 帚型		10	25 河曲群内侧，低洼平坦地区	30 波的多向反射与交汇产生畸变及向量合成
	17 旋涡型		11、12		
	18 卷发型		13		

Key:

(1) Macrotypes of liquefaction
(2) Scattered stars type
(3) Linear type
(4) Network type
(5) Revolving type
(6) Subtypes
(7) Sparsely scattered star type
(8) Dense star type
(9) Star and cloud type
(10) Linear type
(11) Conjugate type
(12) Arc type
(13) Vein type
(14) Tree branch type
(15) Radiative type
(16) Broom type
(17) Eddies
(18) Cirrus type
(19) Diagrammatic illustration of loci of liquefaction
(20) No. of photograph plate
(21) Characteristics of landform and topography
(22) Topography is flat. Landform is a simple coastal plain
(23) Topography is flat. Landform is a simple plain between rivers
(24) The river bend forms a rising bank. It is a low region banking the river where hydrological networks are densely concentrated
(25) The river bends are in groups in the inner side and the region is a low flat area
(26) Main form of surface wave movement
(27) Evenly propagating ground surface traveling wave
(28) Evenly propagating ground surface traveling wave or when traveling waves of two directions meet, or when a traveling wave is partially blocked during its course of travel
(29) Stationary waves are formed by reflection or focusing
(30) Distortion produced by intersection and reflection of waves of many directions and combination of vectors.

and when the porous pressure disperses, the water under pressure will undergo cohesion during its course of penetration. Therefore the diameter of the spewing hole on the ground surface is large and there are many sand piles separated at long distances from each other, manifesting a pattern of scattered stars. Conversely they manifest a pattern of densely scattered stars. When the burial depth of the liquefaction layer is shallow, a pattern of star and cloud shapes is formed.

2. Linear shapes (photographic plates 4, 5, 6)

The images are characterized by a group or several groups of white lines in the pictures. These lines are formed by continuous lining up of sand piles or continuous spewing of sand from cracks on the ground surface. They are parallel and equidistant or in conjugate form. The length of the lines and the distances between lines reflect wide expanse of flat surfaces and the wavelength of surface traveling waves. When the movement of the traveling waves is blocked, the lines bend in various ways to become arc lines.

3. Network shapes (Photographic plates 7, 8, 9)

Because the microlandforms and the structure of the sediments of river bends and river banks are more complex, surface waves are affected by the landforms and boundaries of microlandforms during their course of propagation. This causes visible intensification of the values of amplitudes of motion on the ground surface in certain sections and produces strong shifts and morphological changes.

Network type images often show the following characteristics:

(1) Based on the characteristics of the forms, there are three subtypes, veins, tree branch shapes and radiative types:

(2) All of these loci of liquefaction are related to the tension of the gravity of the cracked zones beside banks.

(3) In "U" shaped or nearly semicircular river bends there are typical vein-like loci. They are parallel to the axial line of the river bend. The distances between them are controlled by the wavelength of the ground surface waves.

(4) Revolving types (Photographic plates 10, 11, 12, 13)

When a group or several groups of horizontal surface waves are affected by different landforms and geological borders during propagation, and when the wave fronts of reflected waves from different directions intersect in different time sequences, the result is equivalent to an intensified turning motion caused by the combination of wave motion vectors of different directions. Its characteristics are:

(1) Usually one or several centers of revolutions can be seen. The axes of the revolutions are mostly perpendicular. The direction of the revolutions is determined by the composite direction of the vectors of the surface wave motion. Therefore the direction of revolution are not all the same.

(2) Surrounding the center of the revolution are many groups of concentric layers of revolutions (these are manifested on the ground surface as surfaces of extended and twisted structures in cracked zones). The number, scale, degree of enclosure and degrees of arc of the cracks in the ground directly reflect the intensity of ground surface movement and the composite angle of the vectors of the wave motion. Based on the scale of the revolution on the ground surface and geometric characteristics, they can be further divided into three subtypes, the broom shaped types, eddies and curls.

It can be seen from the above that ground surface liquefaction due to strong seismic activity does not manifest itself as a simple form but often as multiple and complex geometric designs. Different designs generally reflect the different mechanisms of formation, mechanical characteristics and damaging effects.

III. Analysis of the Mechanism of the Loci of Macro-Liquefaction

Macroloci of liquefaction on the ground surface show the different characteristics of seismic surface movement and the different damaging effects. This is because the values of the amplitudes of surface movements are mainly determined by the geological conditions within the range of influence of a limited depth (generally less than half a wave length), therefore, changes in landforms, topography and structure of the earth's layers can affect ground surface movement of the field and determine the macroloci of liquefaction.

1. The mechanism of formation of the loci of the scattered star type

This is the basic form of the loci of macroliquefaction in the horizontal field. Its process of formation includes the following steps:

(1) The shear stress caused by the earthquake must be stronger than the soil's shear resistance so that the soil granules undergo relative shifts.

(2) The density of the granular structure increases, causing the porous pressure to increase and finally when the body of the soil is subjected to sideways pressure, liquefaction begins. These two steps can be expressed by the simplified formula of H. B. Seed[1] as:

$$\tau_{av}=0.65\gamma h\cdot\frac{a_{max}}{g}\cdot r_d=C_r(\sigma_1/2\sigma_3)\sigma_3' \qquad (1)$$

(3) Under a constant seismic load, beginning liquefaction develops into complete liquefaction. The pressure of moving water created during the process of upward permeation of porous water bearing the pressure as well as the various simultaneous seismic forces upon the liquefaction layer (including pressure of the moving water of the earthquake, stress of the P wave pressure and additional perpendicular seismic forces of buildings)

may all change into the pressure of moving water of the liquefaction layer and exert upward pressure on the covering soil layer.

(4) Porous water that moves upward begins its upward permeation through capillaries, thus at the beginning (the bottommost) the water channels are evenly distributed capillary pores.

(5) Because of the unevenness of the soil structure and the cohesion of water molecules, porous water gradually comes together during the course of upward permeation. The capillary channels become larger pores and finally water spews from the ground surface. Figure 1 shows the mechanisms of the several processes described above of spewing water and sand or "sandy volcanoes" which are most easily seen.

2. Mechanism of formation of linear loci:

Linear loci mostly appear in alluvial plains between rivers. When the ground surface traveling waves are affected by certain boundary conditions they form parallel wave bundles and propagate in the same direction. At this time, the movement on the ground surface is a parallel wave-like undulation. At the peaks, parallel cracks occur on the ground surface because of tension and stress. The porous water bearing the pressure in the liquefaction layer spews out from the cracks and brings along sand and granules of soil and parallel belts are formed as shown in Figure 2.

When another group of parallel wave fronts or wave fronts of another direction occur, the same mechanism will produce the parallel cracks on the ground in different directions. The formation of this kind of loci is limited to the situations where the burial depth of the liquefaction layer is generally smaller or equal to the half wavelength of the surface wave of the field. Where the parallel wave fronts are all in the same direction, the linear loci will extend a long distance. If parallel wave fronts of two different directions move towards one region and concentrate in that region, the length of the cracks will be short because of interferences. Therefore the length and the distance between the extended linear loci are related to the wavelength and the value of the amplitude of the traveling wave.

3. The mechanism of formation of loci of network types:

This type of loci frequently is formed by the focusing of reflected surface waves produced by river bends and river banks (discontinuous boundary faces). The back and forth reflection of horizontal surface waves often causes the summation of the amplitude values of the same phase and produces an intensification of the vibrating amplitudes at parts of the ground surface--stationary waves. The general formula for stationary waves is:

$$u(x,t)=X(x)T(t) \qquad (2)$$

Any kind of belt-shaped surface motion can be approximated and simulated as the free vibration of a bowstring or a rod of length L and having a fixed and point. Its wave motion equation can be derived as:

$$T(t)=A\cdot\sin\frac{n\pi V}{L}t+B\cos\frac{n\pi V}{L}t \tag{3}$$

and harmonic wave motion is:

$$X(x)=\sin\frac{n\pi x}{L} \tag{4}$$

$$u_n(x,t)=\left(A\cdot\sin\frac{n\pi Vt}{L}+B\cos\frac{n\pi Vt}{L}\right)\times\sin\frac{n\pi x}{L} \tag{5}$$

where A, B, are constants, each n value corresponds to a kind of stationary wave. When the velocity of the surface wave, the original frequency and the width L of the river bend are known, the value of n can be obtained from the wave velocity ($V=\frac{fL}{n}$). Taking photographic plate 7 as an example, L $\approx$ 600 meters, f $\approx$ 2.5, $V_{\text{波}}$ $\approx$ 100 meters/second, and thus n (the number of even distributions of network loci on the ground surface within a length of L) is 15. This result is consistent with seismic damage reports. The seismic damage at the site showed a regular damage pattern of about 20 meters of semicircumference (Photographic plates 14, 15). The area of regular pattern of damage is determined by the scope of the stationary wave. Length of the veins also determine the length of continuation corresponding to the peaks of the waves of the stationary wave. The mechanism is illustrated in Figure 3.

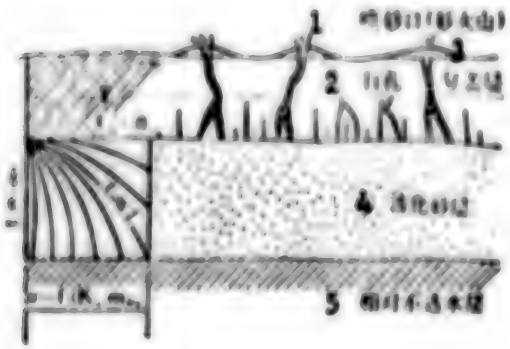


Figure 1. Mechanism of formation of loci of liquefaction of the scattered star type

Key: (1) Spout spewing sand (sandy volcano)
(2) Blind hole
(3) Covering layer
(4) Liquefied sandy layer
(5) Relative layer impenetrable by water

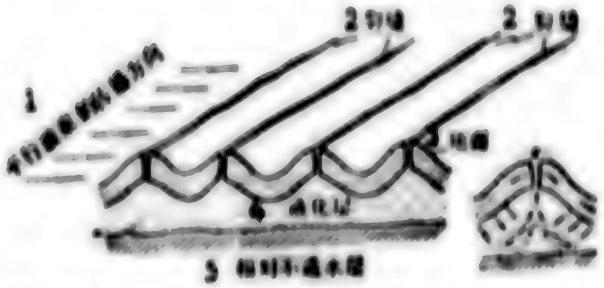


Figure 2. Mechanism of formation of loci of liquefaction of linear type

Key: (1) Direction of propagation of parallel wave bundle
(2) Cracks
(3) Ground surface
(4) Liquefaction layer
(5) Relative layer impenetrable by water

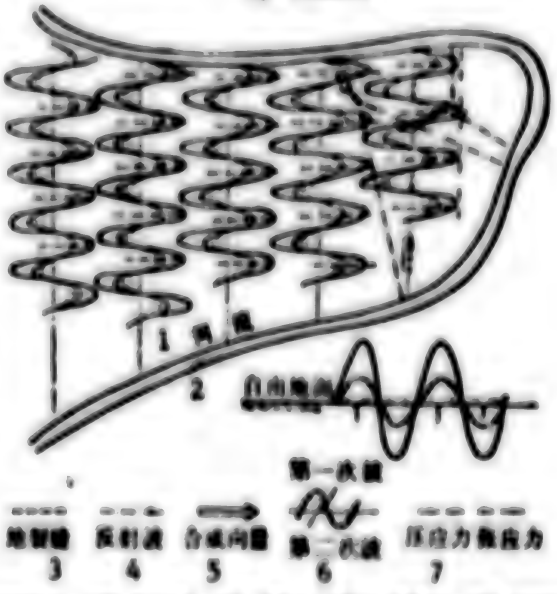


Figure 3. Mechanism of formation of loci of liquefaction of network type

Key: (1) River
(2) Free ground surface
(3) Crack on ground
(4) Reflecting wave
(5) Combined vector
(6) Second wave
(7) Pressure stress tension stress

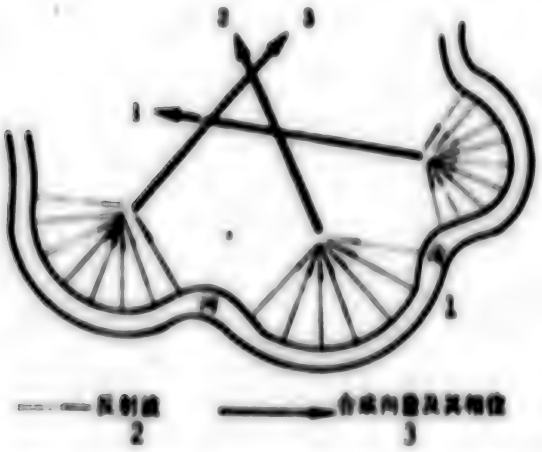


Figure 4. Intersection of reflecting wave and combined vectors

Key: (1) River
(2) Reflecting wave
(3) Combined vector and its phase position

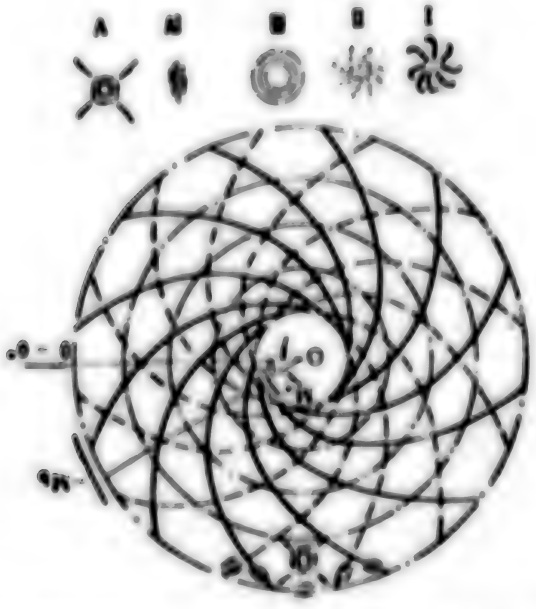


Figure 5. Mechanism of formation of loci liquefaction of the revolving type

I--Loci of tension twisting; II--Loci of pressure twisting; III--Loci of twisting shear; IV--Direction of motion on the two sides of the sheared and cracked surface; V--Stress situation of the single unit within the field

4. Mechanism of formation of loci of revolutions:

These patterns usually are formed by the distortion of wave fronts and convergence of wave fronts caused by the focusing effects of different phases of groups of surface waves in the horizontal field near groups of river bends as well as by multiple refractions and circumdeflexion. When the wave fronts intersect, each wave front arrives at a different time, thus distortion due to interference of wave fronts of different phases and composite vectors of waves are formed (Figure 4). These two occurrences form revolutions of surface movements. Let the twisting moment of the seismic force be M_a, the resistance to the twisting moment of the ground layer be M_b, then the arm of the forces of these two moments revolving concentrically about a common axis is respectively a, b. Use the polar coordinates to transform the wave motion stress tensor of the primary vibration phase into an instantaneous force, make the liquefied layer and its upper cover soil layer as thin plates, and use the condition of equilibrium of stationary forces to solve the axial and tangential stress of the plane stress of the field of wave motion (σ τ). Let the polar angle be θ, the polar distance be r, then the equilibrium equation is[2]:

$$\left.\begin{aligned} \frac{\partial \sigma_r}{\partial r} + \frac{1}{r}\cdot\frac{\partial \tau_{r\theta}}{\partial \theta} + \frac{\sigma_r - \sigma_\theta}{r} = 0 \\ \frac{\partial \tau_{r\theta}}{\partial r} + \frac{1}{r}\cdot\frac{\partial \sigma_\theta}{\partial \theta} + \frac{2\tau_{r\theta}}{r} = 0 \end{aligned}\right\} \tag{6}$$

Let φ be the stress function, then its stress equation is:

$$\left.\begin{aligned} \sigma_r &= \frac{1}{r}\cdot\frac{\partial \varphi}{\partial r} + \frac{1}{r^2}\cdot\frac{\partial^2 \varphi}{\partial \theta^2} \\ \partial\theta &= \frac{\partial^2 \varphi}{\partial r^2} \\ \tau_{r\theta} &= \frac{1}{r^2}\cdot\frac{\partial \varphi}{\partial \theta} - \frac{1}{r}\cdot\frac{\partial^2 \varphi}{\partial r \partial \theta} \end{aligned}\right\} \tag{7}$$

Taking photographic plates 11, 12 as examples, we see that the loci of liquefaction of the revolving type forms a pattern illustrated in Diagram 5. The large and small main stress and the angle α of the polar radius can be obtained from the Coulomb-Mohr theory of intensity:

$$\tan 2\alpha = \frac{\tau_{r\theta}}{(\sigma_r - \sigma_\theta)/2} \tag{8}$$

$$\alpha = \frac{1}{2}\tan^{-1}\frac{2\tau_{r\theta}}{\sigma_r - \sigma_\theta} = \pm 45^\circ$$

Using the diagrammatic method, the loci on the surface of the greatest (pressure) and smallest (tension) major stress of the eddy type loci can be obtained. The series of ground surface tension or cracks due to twisting produced under this kind of stress destroys the effective covering function of the upper covering soil layer and thus creates a large area of violent liquefaction in the area.

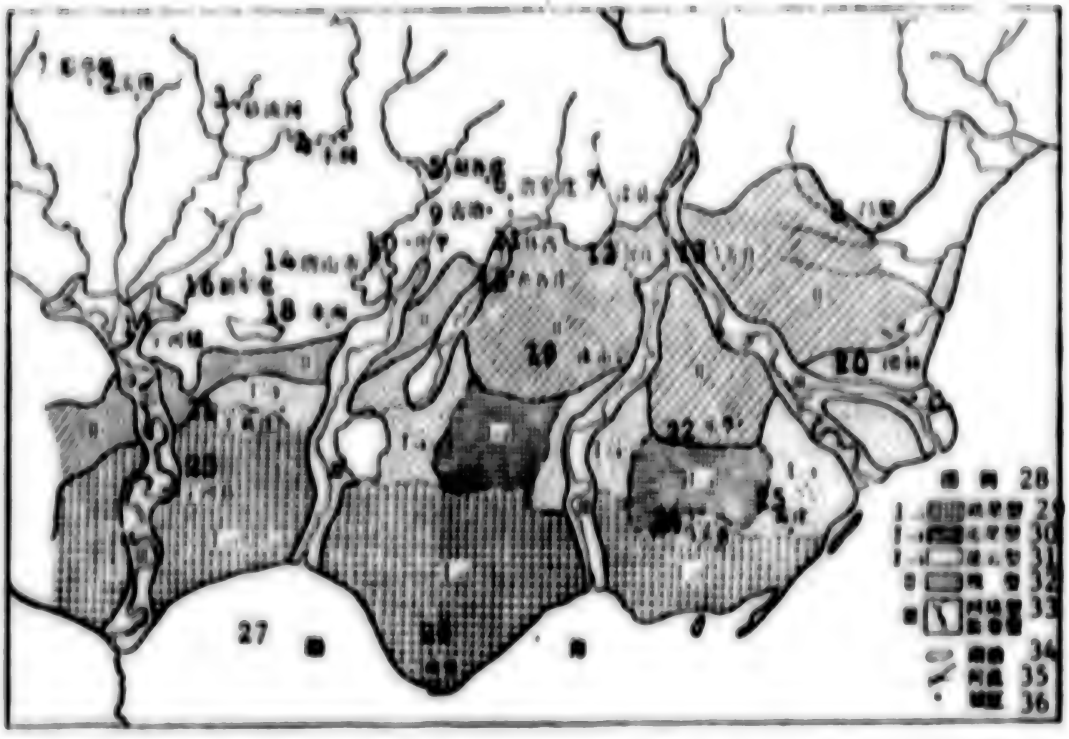


Figure 6. Regional diagram of liquefaction of the Tangshan earthquake area

Key:

(1) Caitingqiao
(2) Yutian
(3) Shaliuhe
(4) Fengren
(5) Zhaogezhuang
(6) Tangjiazhuang
(7) Luanxian
(8) Changli
(9) Guye
(10) Kaiping
(11) Linxi
(12) Lixingzhuang
(13) Mafangying
(14) Tangshan city
(15) Fangezhuang
(16) Xinjuntun
(17) Ninghezhen
(18) Fengnan
(19) Luannan
(20) Tuanlin
(21) Wanglanzhuang
(22) Leting
(23) Ninghexian
(24) Matouying
(25) Huangzhuang
(26) Nanbao
(27) Bohai
(28) Legend
(29) I-1 Scattered star type
(30) I-2 Dense star type
(31) I-3 Star and cloud type
(32) II Linear type
(33) III Network type
Cirrus type
(34) Lake
(35) River
(36) City and town

Table 2. Seismic Damage of Different Types of Liquefaction

Macrotypes of liquefaction	Subtypes	Distance (meters) between holes spewing water and sand	Percentage of seismic damage	Condition of seismic damage
Scattered star type	Sparsely scattered star type	100	20	Seismic damage to the ground surface is slight. Damage is mostly manifested by cracking walls and sinking of foundations of buildings. During the course of liquefaction, there were two factors that weakened the force of the earthquake: One was the liquefaction layer could not effectively transmit the shear stress and the shear waves were blocked, thus reducing greatly the value of the amplitude of ground surface movement. The second was that as the liquefied sandy layer became dense mostly uneven sinking occurred.
	Densely distributed star type	< 50	40	
	Straight line type	< 20	40	
Linear type	Straight line type	< 10	40~50	Relatively severe damage was done only to free ground surfaces and the system of ditches in farmland. The condition of damage was determined by the thickness of the non-liquefied surface layer and wavelength of the ground surface wave of the locality
	Conjugate type	< 10	40~50	
	Arc type	< 15	40~50	
Network type	Tree branch	30 ~ 50	90	The ground surface shows a regular pattern of damage and seismic damage was serious. Houses were toppled or severely split open. Buildings sank unevenly. The places most severely damaged by seismic forces were at the center of the river region (focal point).
	Vein type	50	60	
	Radiative type	< 20	90	

[Continued on following page]

[Table 2 continued]

Macrotypes of liquefaction	Subtypes	Distance (meters) between holes spewing water and sand	Percentage of seismic damage	Condition of seismic damage
				Simultaneously, slipping of the ground surface along the rivers also occurred seriously. The embankments of the river were destroyed and cracked and the river channel was blocked. In the planning of buildings and in measures to prevent damage by earthquakes, consideration should be given to the following: Regions of extreme river bends and focal points of river bends should be avoided. The length of buildings should not be longer than the wavelength of the surface waves. The vertical direction of the buildings should be parallel to the symmetric axis of the river bend.
Revolving type	Broom type	Radius of curvature 100	80	Serious seismic damage occurred on the ground surface. Buildings suffered seriously from horizontal twisting and shearing. Houses were toppled. The ground surface was seriously distorted and uneven sinking and seismic depressions occurred. Regional underground water level generally rose. A series of densely concentrated tension or twisting type cracks on the ground surface occurred.
	Eddies	Diameter 500~1000	>90	
	Cirrus type	Width of belt 30	75	

IV. Relationship Between the Macroliquefaction and Ground Surface Seismic Damage

Different patterns of liquefaction reflect different mechanisms of formation of liquefaction and the different effects of seismic damage on the ground surface. This has already been proven to be true by seismic surveys. At the same time, the various patterns of liquefaction not only reflect the inner relationship between the structure of the soil layers and related dynamic parameters but also clearly reflect the control exerted by microlandforms and topographical conditions.

Because liquefaction of the field is usually a continuous and hereditary pattern in time, it is possible to realize engineering and geological zoning (Figure 6) of the field of liquefaction using aerial photographs taken after an earthquake after understanding the different patterns of liquefaction and their effects of seismic damage (Table 2), the mechanism of formation and the controlling conditions. The information can also be used to predict the characteristics of seismic damage on the ground surface produced by future earthquakes in a certain area as well as serve as a reliable basis for earthquake resistant engineering projects.

Undoubtedly because the above method is easy to implement, and highly reliable, its potential in the study of earthquake engineering is valuable. Even though studies are still being conducted in such factors as the patterns and their relationship with material nature, the analysis may contain some errors. Yet we hope to obtain answers in further studies.

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EXPERIMENTAL SYSTEM OF COMPUTER NETWORKS STUDIED

Shenyang ZHONGXIAOXING JISUANJI [MINI-MICRO SYSTEMS] in Chinese No 2, 25 Apr 80 pp 1-11

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[Text] Abstract: This article is mainly an introduction to the study of an experiment to build a computer network using medium and small sized computers, and the study of an experiment to establish data communications lines during the course of building the network. The design and production of the equipment for computer data conversion and communications interface equipment and compilation of software for the control and compatibility between communications and computer conversions were completed.

Foreword

The concept of a computer network was proposed in 1960 jointly by two Americans, Robert and Wesler. They proposed: "to connect via communications lines several self regulating computer systems so that the resources of each computer system can be mutually shared among several computer systems. This kind of combination (network) is called a computer network. Computer users who join in the network can use their own computers and can also freely use the computers within the network."

Under the drive of this thought, the first network that went into operation was the ARPA network of the United States in 1969.

At present, the world already has eight large scale computer networks engaged in message exchange and storage.

Applications of computers have progressed from the first generation batch processing systems to the second generation on-line real time systems, to the third generation time sharing systems, to the present fourth generation computer network operations.

The modern computer networks have two types of structures. One is the computer communications network. From the point of view of the user, the network is itself a conglomeration of many systems possessing much service equipment and processing capabilities. Position of the source system sought by the user is assigned by man. The second is the computer network. From the point of view of the user, the entire computer network is a large scale computer system. The user uses the resources of the network according to a communications agreement. The user need not know the position of the source system, and the system is decided by the software.

The actual meaning of a computer network is:

--The highest form of application of computers at present.

--The computer resources are shared by all kinds of users.

--There is a main frame with front communications processors, data exchange circuits and terminal processors or intelligent terminals.

Part I--General Introduction

I. General Description

The research and development of the experimental system of a computer data processing network achieved preliminary success in March of 1979 after one year of designing and matching the hardware system. Research, development and debugging of software were preliminarily completed after half a year. Experiments and tests in communications operations showed that the hardware system of the computer network has been preliminarily established but software still needs improvement. This is a preliminary try in the study of a network system of computers whose computer resources are shared by all kinds of users far and near. Experiments have shown that under present conditions, utilization of the computers frequently being used in our nation at present to establish a system with network functions is feasible. This kind of research work has practical significance. It has provided advantageous conditions for developing computer network techniques and providing services for information processing for multiple users and for the study of other applications.

This computer network consists of a central processing unit (main frame) DJS-6 (i.e., 108 secondary machine) medium sized computer, the front communications processor DJS-130 small computer, data exchange equipment, city communications lines, and the terminal processor p6060 system.

During the course of studying this computer network, the following hardware were researched and designed: (1) The interface of the data exchange channel between the front communications processor and the main frame, ile., the interface of the program channel between the two computers DJS-6 and DJS-130. (2) The communications interface of the front

communications processor, i.e., the asynchronous multiplex data communications equipment, capable of complete duplex and semi-duplex communication via 20 circuits. (3) Research in the configuration of the system of terminal processors, i.e., combining the personal minicomputer system p6060 and the microcomputer system p6040 and the communications terminal TC-485 manufactured abroad into a terminal system for multiple users.

Research and development of software included the following: (1) Software for the control of communications operations of the DJS-130 computer. (2) Program for the control of data exchange procedures between the main frame and the front communications processor. (3) Control programs for the communication between terminal processors.

The research and development of these programs are all modular in structure and the programs are added to the original system of operation.

II. Structure and Functional Indicators of the Computer Network

The structure of the present computer network is a point-to-point star shaped and expandable structure. Its block diagram is shown in Figure 1.

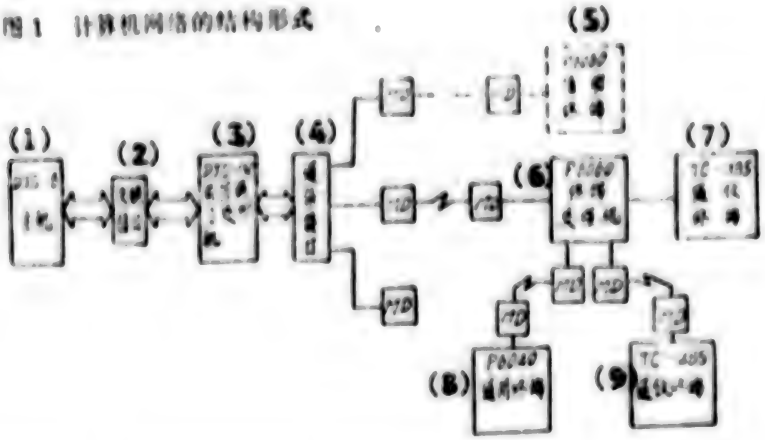


Figure 1. Structural form of the computer network

Key:

1. Main frame
2. Exchange interface
3. DJS-130 front communications processor
4. Communications interface
5. P6060 active terminal
6. P6060 terminal processor
7. TC-485 communications terminal
8. P6040 general purpose terminal
9. TC-485 communications terminal

The functional indicators of this network are as follows:

Network form	Star shaped centralized
Sizes and types of computers	Different type (medium, small and microcomputer)
Number of stations	Three (present)
Positions of nodes	Beijing area
Communications network processor	DJS-130, p6060
Form of circuits	Exchange circuits
Form of exchange	Messages are grouped, stored and exchanged
Medium of transmission	Telephone lines (wide and narrow bands, interference)
Data transmission rate	50 baud - 1200 baud
Form of transmission	Simulated
Message form	Variable length (longest 255 bytes)
Length of message	(Greatest) 2040 bits
Shared hardware resources	Yes
Shared software resources	Yes

III. Several Problems That Were Solved in Network Design

1. Data Exchange Between Computers

In modern computer networks, there is usually a communications processor. It takes up the massive amount of communications processing tasks originally to be completed by the main frame and completes processing (such as data buffering, control of buffered zone, control of communications lines and peripheral equipment, network control, message queuing, corrections control, format setting and editing and such data communications functions). It serves on the one hand as the communications connection between the main frame and the terminals, and on the other hand it serves as the nodes of the network. The DJS-130 computer and the DJS-6 computer are machines of two completely different systems and structures. The DJS-130 computer is more advanced in speed, functions and structure. The principle of processing of communications exchanges between the two machines is to

assign all the control functions for completing data exchange to the communications processor and to regard the main frame as only a type of intelligent peripheral equipment. Because the meaning of exchange is mutual, the purpose of the exchange interface we set up between the main frame and the communications processor is to develop for the DJS-130 computer a set of interface equipment for data input and output. Words for input and output states, interruptions, queuing and circuit control functions are all performed on the DJS-130 computer and the interface is designed according to the standard interface equipment for the 130 computer. On the DJS-6 computer are installed channels for data exchange with the communications processor, reformed control commands and equipment for the conversion of electric equilibrium and electrical insulation between the two computers.

2. Study and conclusion of the experiment of the theory of transmission via the city's telephone and telegraphic channels

(1) When the noise of the electric equilibrium over the city's telephone lines is between -45 and -55 decibels, the emitting electric equilibrium can be about 0 decibel. The receiving electric equilibrium after operator assisted connection is made may reach -20 to -25 decibels and the quality of reception is relatively satisfactory.

(2) The percentage of wrong number dialing during non-peak hours via the city's phone lines is generally between 1×10^{-4} and 5×10^{-4}. Figure 2 shows the statistical pattern of daily change in wrong number dialings via the city's telephone and telegraph lines.

(3) The length of the transmission group (subgroup of message) is related to the quality of telegraphic channels. During the peak hours of the city's telephone lines, the quality of the telegraphic channels is poor. Feedback and the retransmission rate may reach between 120 and 150 percent or more. If the code groups are shortened at this time, the number of repeated transmissions visibly drops. Generally during the day time, the number of repeated transmissions of a message of data of group length (122 words) via the city's telephone and telegraphic channels constitutes between 10 and 30 percent of the total number of transmissions. After working hours, the percentage of repeated transmissions visibly drops to about 5 percent. During the night, the percentage of repeated transmissions is only 0.1 to 1 percent. The daily change of the percentages of repeated transmissions of data transmitted via the city's telephone and telegraphic channels are shown in Figure 3.

(4) The relationship between the best group length and the percentage of wrong number dialings.

According to studies of the model of the random binary symmetric channel (BSC) and the numerical model of the spontaneous binary symmetric channel (GBSC), the mathematical function of group length C, word length N,

percentage of wrong number dialing P_e and transmission efficiency η_c can be obtained by the method of control of the two types of errors of matrix codes and cyclic codes frequently used in the city's telephone and telegraphic channels. Figure 4 shows the relationship between transmission efficiency η_c and group length C.

According to the relationship $n_c \sim C$, the relationship between the best group length C_0 and the percentage of wrong number dialing P_e can be obtained as shown in Figure 5.

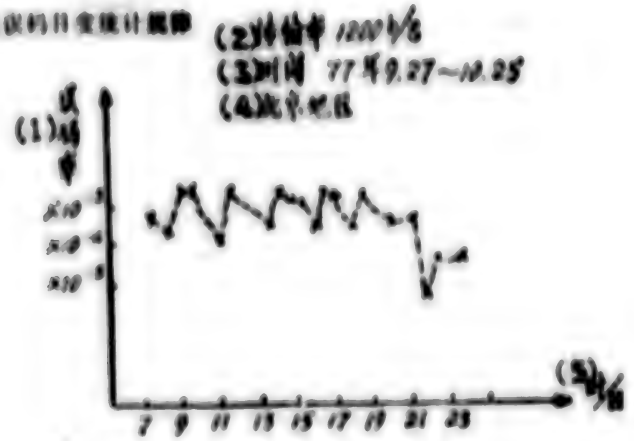


Figure 2. Statistical pattern of daily change in wrong dialings via the city's telephone and telegraphic channels

Key:
1. Percentage of wrong dialings
2. Transmission rate
3. Time
4. Beijing area
5. Time/day

Office hours Pe = 4 x 10^{-3} even 10^{-2}

After 8 pm

Non-high peak hours

图 3 [illegible]

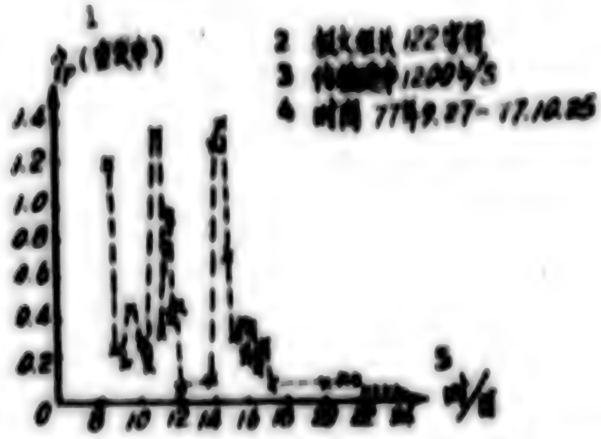


Figure 3. Daily change of repeated sending rate of transmission of data via the city's telephone and telegraphic channels

Key:

1. Repeated sending rate
2. Message group length 122 characters
3. Transmission speed
4. Time September 27, 1977 to October 25, 1977
5. Time/day

Peak

Shortened code group

C = 122 characters, daytime

After working hours

Night time

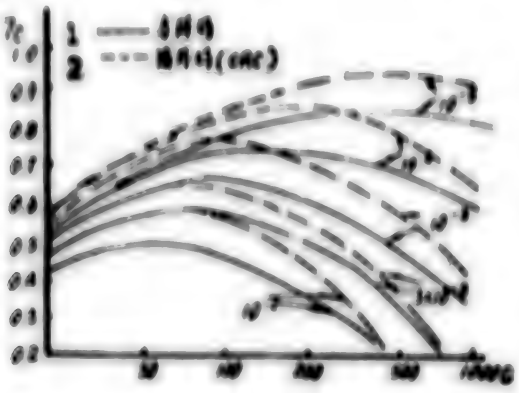


Figure 4. Relationship between group length C and transmission efficiency η_c

Key:
1. Square matric code
2. cyclic code

Conclusion:

1. Cyclic code is superior to matrix code
2. When η_c is fixed, the best group length is Co.

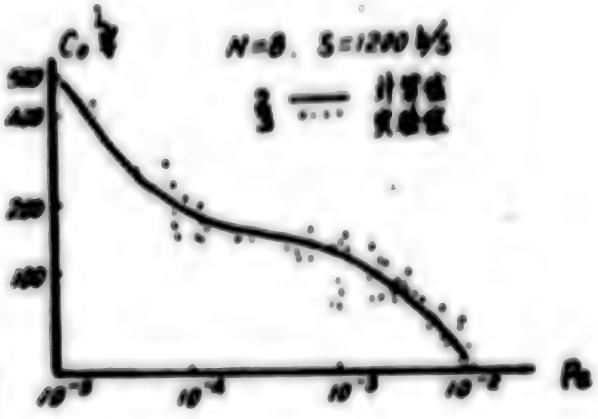


Figure 5. Best group lengths under different wrong dialing rate Pe

Key:
1. Words
2. Computed value
3. Experimental value

Best group length is related to many factors

1. Daytime words
2. Night time words
3. Co does not surpass 400-500 words

(3) Determining the number of communications channels by the storage capacity of the main frame computer DJS-130

The lowest storage capacity of the DJS-130 computer is 16K. The operational system with a communications control program requires 6K. A buffer zone of 10K can be set up.

The longest word length of the subgroup message is 255. The greatest throughput of information via several communications circuits (each is a duplex) is:

$$n \cdot 255 = 10K \qquad n = \frac{10K}{255} \approx 40.$$

Thus the communications interface of the communications control has 20 lines.

4. Design and Writing of a Communications Program for the Front Communications Processor

(1) The DJS-130 computer's communications control program uses the RTOS real time operations system of the NOVA computer (the magnetic disk, magnetic tape and multiple path converter have been removed). Three modules are added to the systems program: A system call module (there are a total of 10 system calls such as request, release, off-hook, input recognition sequence, message grouping, termination sequence, transmitting recognition sequence, message grouping, termination sequence).

module for long range I/O interruption processing

Module for the 108 computer's interruption processing.

(2) A task module for executing communications procedures in the applied program is added.

Far end terminal I/O task

108 I/O task

Message analysis task.

(3) Three linked plate commands are added to the pseudo-task linked plate commands for artificial connections and disconnections.

The RTOS system has a 4K program. Of these, 1K was removed and another 3K were added forming a 6K (6450 lines) program.

5. Study of the Configuration of the Terminal Processor System

The personal small computer p6060 was used as the center for arranging the terminal configuration, P6060 - p6060; p6060 - p6040, p6060-TC - 485 - PR1230. These are all microprocessor systems. User oriented language is BASIC. A communications control program was written in BASIC-level. The compiled object program occupies 4K.

6. Program for Controlling Data Exchange Between the Main Frame and the Front Communication Processor

It is not necessary to develop specialized network software for the DJS-6 computer. Only revisions of and supplements to the presently available software are required to adapt to the requirements of the network.

Operations are carried out entirely according to the compiled rules using ALGOL. The main frame now treats the front processor as a type of I/O equipment and thus taking control of data exchange.

Added to the systems program are a new interruption processing function, information input control and processing function, command processing function, and output information processing and editing function.

Part II--Design of Communications and Exchange Interface

This section briefly describes the main hardware that was designed by ourselves, the design of the communications interface of the front communications processor and the design of the exchange interface between the front communications processor and the main frame, called the communications controller as a whole.

I. Communications Controller

This communications controller is designed especially for the DJS-130. Its purpose is to control data exchange between the DJS-6 and the long range terminal. To satisfy this goal, the design took into consideration the following main points:

--The communications procedures and the specifications of the interface follow the "basic communications procedures" promulgated by the Fourth Ministry of Machine Building. The interface circuits satisfy the suggestions of CCITT V_{24}.

--The interface between the communications controller and the DJS-130 is completely up to the interface standards of all the circuits of the DJS-130.

--Some specifications are taken as reference from the original NOVA-1200.

1. Technical Indicators

The major technical indicators of the DJS-130 communications controller is listed in Table 1.

2. Structure

The communications controller consists of three interfaces: a multiple path communications interface, an interface with the DJS-6 computer (the exchange interface), and a real time interface. These interfaces are all independently hooked on to the main input and output lines of the DJS-130 computer. They exchange data with the DJS-130 via the program channels. The multiple path communications interface can select the number of routes of communications control according to the demands of the user.

3. Working Principles of the Communications Interface

The block diagrm of the principle of the communications interface is illustrated in Figure 6. It occupies two implementor names. One is used for data output and the other is used for data input. Multiple path control is realized by changing the configuration of the implementor name. The configuration of the implementor names is shown in Table 2.

Implementor names must be used in pairs. The user can also define the implementor names themselves. The hardware of the communications interface provides the function for selection of implementors.

Each route of the communications interface possesses a status register and data register. The status register is further divided into the input status register and the output status register. They register the status of the interface circuit of the communications interface and allow the program to inquire and control the circuit in the communications interface. The definition of each status position is shown in Table 3.

表 1

1 功 能	16 内 容
2 通信方式	17 全双工，半双工
3 同步方式	18 异步（一个或两个停止位可选）
4 字符单位	5,8
5 通信速度(b/s)	50,75,100,200,300,600,1200,2400
6 连接线路	19 交换线路，专用线路，二线或四线
7 可连接的线路数	20 5对（可扩至20对）
8 字符系列	21 任意
9 缓冲	22 一个字符
10 报文校验	23 垂直校验用硬件，水平校验用软件
11 报文交换方式	24 分组存储交换，由软件实现
12 时间监测	25 由控制器提供1.25ms,10ms,100ms,1s可选的实时钟，由软件实现各种时间的监测
13 控制方式	26 由软件实现
14 与异种计算机接口	DJB—8（108乙）
15 通信规程	27 基本通信规程

Table 1.

Key:

1. Functions
2. Communications method
3. Synchronous method
4. Character unit
5. Communications speed (b/s)
6. Connecting circuits
7. Connectable circuit numbers
8. Character series
9. Buffer
10. Message checking
11. Message exchange method
12. Time monitor
13. Control method
14. Interface with a different type of computer
15. Communications procedures
16. Content
17. Complete duplex, semi-duplex
18. Asynchronous (flexible one stop or two stops)
19. Exchange circuit, special circuit, two or four circuits
20. 5 pairs (can be expanded to 20 pairs)
21. Any
22. One character
23. Use hardware for vertical checking, use software for horizontal checking
24. Storage and exchange in groups realized by software
25. The controller provides selective real time clocks of 1.25 ms, 10 ms, 100 ms, 1s, and the software monitors the various times
26. Realized by software
27. Basic communication procedures

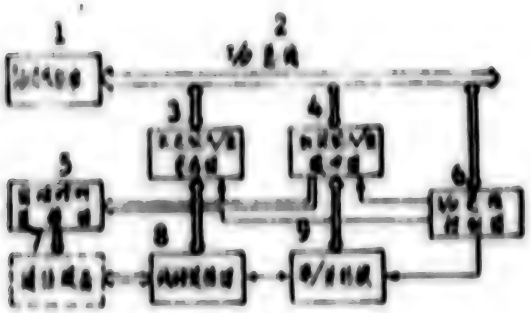


Figure 6. Block diagram of the principle of communications interface

Key:
1. I/O bus drive
2. I/O bus
3. State input/output register
4. Data input/output buffer
5. Automatic calling connector
6. I/O bus controller
7. Communications equipment
8. Circuit connector
9. Series/parallel conversion

1							
2							

Table 2.

Key:
1. Number of receiving equipment
2. Number of emitting equipment

1 [illegible]	2 [illegible]	15	14	13	12	11	10	9	8	7	6	5	4
3	A	JEC	108	125	210	107	238	205	109	204	121	215	122
4	B	207	211	108/2	106	120	C_{Qd}		2				

Table 3.

Key:
1. Name of register
2. Number of digits on bus
3. Input
4. Output

JEC is the odd-even error zone bit.

C_{Qd} is the trigger that initiates the transmission of signals from the communications interface for program control.

The rest of the numbers all designate the interface circuits suggested by V_{24} in CCITT.

In transmitting data, three basic input/output commands are used.

DOB--this means to transmit the status word of the interface circuit that controls the communications equipment from the AC accumulator to the output status register according to communications procedures.

DIBC--this means to access the present status of the interface circuit of the communications equipment from the input status register and transmit it to the AC accumulator.

DOAC--this means to send the data to be transmitted from the accumulator AC to the data output buffer.

When receiving data, two basic input/output commands are used.

DOBC--this means to send the status word of the circuit that controls the communications equipment from the AC accumulator to the output status register to control the circuits on the communications equipment.

DIAC--this means to access the already installed data in the data input register and send them into the accumulator.

When conducting an automatic call, the basic input/out commands are the same as the transmitted data if the computer is executing an automatic call to the user. As long as the program exercises control according to the procedures of automatic calls of V_{25}, automatic calls can be realized.

The numbers of automatic calls are given by the 8 - 11 digits of the AC accumulator. When the user executes an automatic call to the computer, only the two basic commands of DIBC--and DOBC--are needed. The former accesses the interrupt status word to judge whether it is an 125 interrupt request. The latter sets the 108/B and executes the automatic call.

The interrupt queue of the communications controller is connected to the queued output of the DJS-130. Its internal queuing order is: DJS-6 interface transmitter--DJS-6 interface receiver--real time clock--communications interface reception--communications interface transmission. Their interrupt mask digits are shown in Table 4.

The communications interface has many interrupt requests and the definitions of these interrupt sources are shown in Table 5.

The 1 - 7 interrupt sources do not form a C_{JS} mark. Only the interrupt request by an already entered character and the interrupt request for a next character when transmission of one character has been completed form the C_{JS} mark. The interrupt sources numbered 1 to 8 are formed at the receiving end of the communications interface.

The communications controller has various distribution and scheduling functions and adjustments can be conveniently made.

II. Exchange Interface of Two Machines

According to the design of the entire system with the DJS-6 as the main frame and the DJS-130 as the front processor, an interface controlled both by the DJS-6 and the DJS-130 needs to be designed so that the two computers can be connected to realize exchange and control of information between the two machines.

The design principle is to regard each machine as the peripheral equipment of the other. The exchange of information is carried out in the form of operational responses, i.e., in the form of program interruption. One byte is exchanged each time. One interruption is transmitted when one byte is exchanged. The exchange proceeds by one byte at a time. The interruption time of the DJS-6 computer is about 8 μs, and that of the DJS-130 is about 2 μs.

The program of the interrupt system of the DJS-6 includes error interruption, teletype input and output interruption, wide line printer interruption, curve interruption and program trace interruption. The priority of error interruption is the highest. There are only two classes of interruptions. To realize exchange of program interruption between the DJS-6 and DJS-130 a transmission of interruption from the DJS-6 to the DJS-130 and from the DJS-130 to the DJS-6 must be added. But it is difficult to make a relatively big change in the interrupt system of the DJS-6 computer

because of structural limitations of the machine. Since the curve and trace interruptions of the DJS-6 computer are not utilized much at present, even not used, and to simplify work, the interrupt system of the JDS-6 is not changed. Instead, the original curve interruption has been used for transmission from DJS-6 to DJS-130, and the trace interruption has been used for transmission from DJS-130 to DJS-6.

1	3	4	5	6	7
2	8	7	13	12	10

Table 4.

Key:

1. Name of interface
2. Corresponding masking digit
3. DJS-6 interface emitter
4. DJS-6 interface receiver
5. Real time clock
6. Communications interface emission
7. Communications interface reception

1	3 2	4
1	106	5
2	125	6
3	210	7
4	107	8
5	205	9
6	204	10
7	121	11
8	14	12
9	15	13

Table 5.

[Key on following page]

Key:

1. Sequence number
2. Function
3. Interruption source
4. Function
5. Interrupt request responding to the 105 request for transmission
6. Interrupt request formed by the call for the far end terminal
7. Interrupt request responding to demands of the automatic calling equipment for data display
8. Interrupt request responding to the 108/B request on the circuit of the communications equipment
9. Interrupt request formed by failure of automatic call
10. Interrupt request formed by successful automatic call
11. Interrupt request responding to the 120 request for transmission via communications channels in reverse direction
12. Interrupt request sent after character has been loaded
13. Interrupt request for giving the next character after one character
14. Input ready
15. Output ready

1 [illegible]	9 [illegible]
2 [illegible]	10 [illegible]
3 [illegible]	11 [illegible]
4 [illegible]	12 [illegible]
5 [illegible]	13 [illegible]
6 [illegible]	14 [illegible]
7 [illegible]	15 [illegible]
8 [illegible]	16 [illegible]

Table 6.

Key:

1. Function
2. Exchange method
3. Character unit
4. Highest exchange rate
5. Character system
6. Connecting circuit
7. Information electrical equilibrium
8. Control method
9. Content
10. Complete duplex, asynchronous method of interrupt request and response
11. 8 units
12. One direction 125K bytes/second
13. Any
14. Parallel, special bus method, long line transmission
15. Different, ground lines of the dual machines are insulated, electrical equilibrium conversion.
16. Machine-linked exchange control program

2. Operating Principle of the Exchange Interface of the Two Machines

The logic block diagrams of the exchange interface between the two machines are illustrated in Figure 7. The interface has a receiving part and a transmitting part. They occupy two implementor names. The control register and the compiler circuits in the interface consist of the interface control trigger, the implementor name compiler and circuits of the standard DJS-130. The data receiving and transmitting registers are both 8 digit data registers. The purpose of the electrical equilibrium conversion curcuit is mainly to solve the conversion of positive and negative logics and for electrical insulation between the two machines. The DJS-6 is a negative logic device and its ground line is suspended. The DJS-130 is a positive logic device and its ground line is grounded. Therefore the electrical equilibrium conversion circuit is coupled by a transformer.

(1) Transmission From DJS-130 to DJS-6

The DJS-130 executes an output control command DOAS30. The data is output to the interface register. This initiates the interface to request an interruption towards DJS-6. The DJS-6 responds to the interruption and executes command 73E to access the data and executes 73F as a response signal. The flow chart is illustrated in Diagram 8.

(2) Transmission from DJS-6 to DJS-130.

DJS-6 executes output control command 73A. Command 73C initiates the interface and completes data output. The transmitted data register receives the data. When the responding transmission by DJS-130 is interrupted, command DIAC31 is executed to retrieve the data, and the data are processed according to content. After completion, a response signal is sent to DJS-6. The flow chart is illustrated in Figure 9.

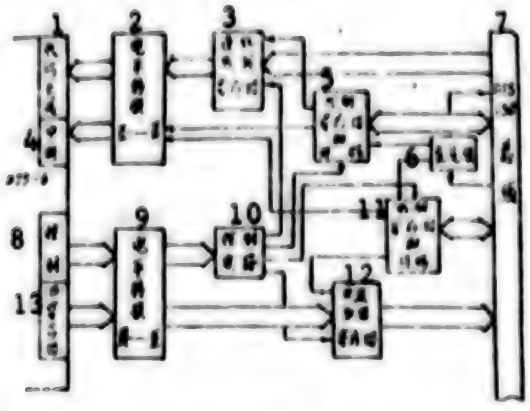


图 7

Figure 7.

[Key on following page]

Key:

1. Code bus
2. Electrical equilibrium conversion Positive-negative
3. Register for overload data received
4. Interruption
5. Control register and translation of codes
6. Priority level
7. DJS-130 bus
8. Control
9. Electrical equilibrium conversion Negative-positive
10. Control circuit
11. Control register and translation of codes
12. Transmitted data register
13. B register

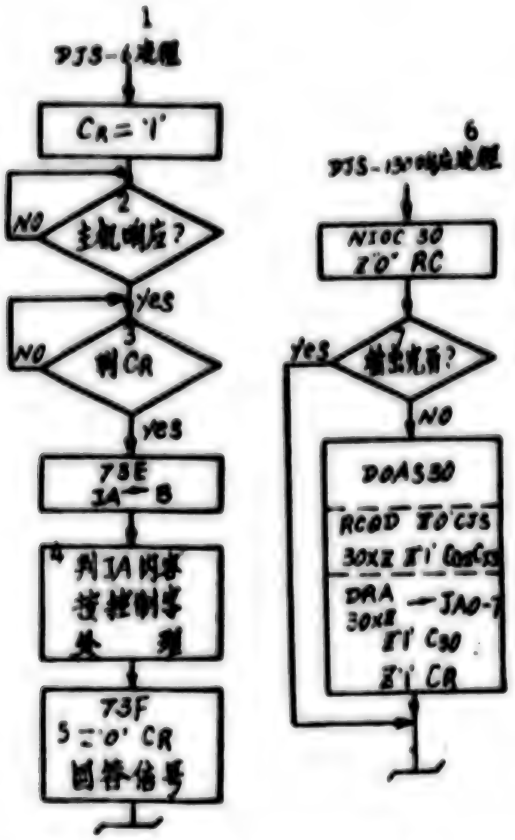


图 8 DJS—6 接收流程图

Figure 8. Flow chart of reception by DJS-6

Key:

1. DJS-6 Flow Chart
2. Main frame response?
3. Decision CR
4. Decide JA content
   Process according to control word
5. 73F A'0' CR answer signal
6. DJS-130 response flow chart
7. Output completed?

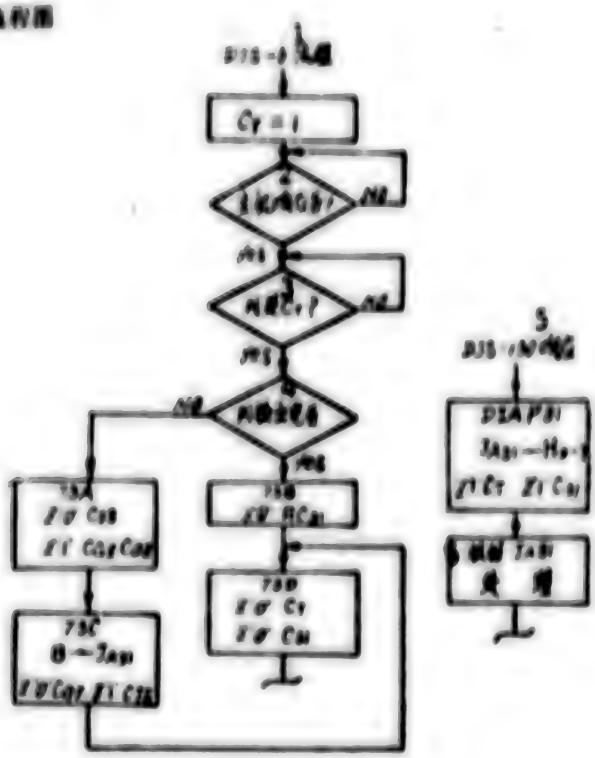


Figure 9. Flow chart of transmission by DJS-6

Key:

1. DJS-6 flow chart
2. Main frame response?
3. Decide C_T?
4. Decide output completed
5. DJS-130 response
6. Process according to JA31

Part III--Communications and Exchange Software

This section briefly describes the major content and part of the block diagrams of the designs of the communications control program of the DJS-130 and the exchange control program of the two machines.

1. The Communications Control Program of the DJS-130

1. Program Function

This program realizes the requirements of using the DJS-6 computer as a long distance intelligent terminal. It can receive three messages in real time from a long distance intelligent terminal according to the stipulations for communications procedures of the international standards

ISO 1745-73 (information processing and data communications control procedures). The communications procedures also coincide with the data communications procedures established by the Fourth Ministry of Machine Building. At the same time, the computational results of DJS-6 can be returned to the terminal.

Since the DJS-6 is a single channel machine, peripheral storage is limited. Therefore when used as a far end terminal it monopolizes the main frame machine but it can communicate back and forth at any time. When the main frame machine is replaced, only the connecting program between DJS-130 and DJS-6 needs to be changed. This communications control program can still be used.

2. Program Structure

Based on the foundation of the RTOS operating system of the original NOVA 1200 computer, a system call that executes the communications procedure, an inner storage distribution program, an interruption processing program between the DJS-130 and the long distance intelligent terminal, programs for the input and output tasks of the long distance terminal and for the input and output tasks between the DJS-130 and the DJS-6 computers, a program for interruption processing between the DJS-130 and the DJS-6 computers, and a program to facilitate the control of communications task are added. Program blocks for keyboard commands have also been added.

(1) System call program block: This includes request and release of the buffer zone of the internal storage, input and output inquiry sequence, input and output messages, input and output terminating sequence, and on-hook and off-hook of messages.

(2) Interruption processing program block: This executes and checks the communications procedures according to the basic procedures of the international standards ISO 1745-73 for the information processing--data communications system.

(3) The long distance terminal's input and output task block is based on the real time operating system of the original RTOS, the added system call commands and user time to control the input and output of messages at the far end.

(4) Keyboard command program block: This realizes man-machine interaction. It is a program that enables man to inform DJS-130 to "open a line" (artificial call) via keyboard commands or to notify it of "a line breakdown," set up checking circuits and restore communications.

(5) Connecting program block between the DJS-130 and the DJS-6 computers: This includes a program to analyze far end messages of the DJS-13o, input and output task programs of the DJS-6, and the interruption processing program block. This part processes the unpacking and packing of messages and is unrelated to communications control programs.

3. Major Program Block Diagrams

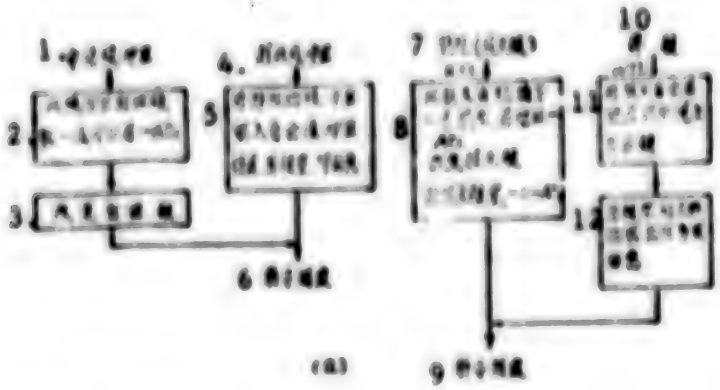
(1) Rough Block Diagrams of System Call Component

Figure 10 shows all the block diagrams of the system call processing program.

(2) Rough Block Diagrams of the Far end Interruption Processing Program

In interruption processing, the process begins from the general interruption entrance and enters the interruption entrance of each equipment, then goes from the input and output programs of the far end equipment through the skip lists into the following programs. The skip lists are ranked under the interrupt status words. Input of one group of message passes through F = 0, 1, 2, 3, or 4 states. Figure 11 shows the block diagrams for input interruption processing.

In the input state, output interruption occurs because the returning character has reached the far end terminal and is processed as in F_{005}. In the output of messages in F = 5, 7, 10, 11, 12 states, the responses after repeated transmissions during output or responses after output ends are processed in F_{15}, F_{112}, and F_{113}. Figure 12 shows the block diagrams of positive and reverse response sequence processing. Figure 13 shows the block diagrams of output interruption processing. Figure 14 shows the block diagrams of turn-around processing.



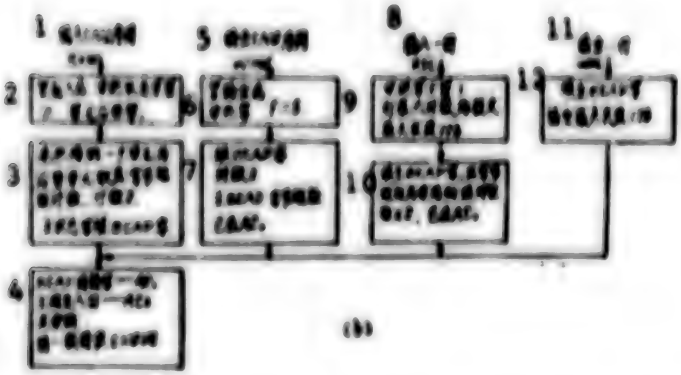
(a) Block diagram of buffer zone processing

Key:

1. Request buffer zone
2. Free linkage from buffer zone
   Access - beginning buffer zone - AC_1
3. Change of free linkage
4. Release of buffer zone

[Key continued on following page]

5. Link the released buffer zone with free buffer zone
6. Revolution call
7. Off hook (message chain)
8. Detach a message from the beginning chain of the message
   The first address AC_1
   Change the message chain
   Original message chain is empty, -1-AC_1
9. Revolution call
10. On hook
11. Hook the beginning of the message onto the end of the corresponding chain and send the chain
12. The original chain is empty, send signal to terminal to output



(b)

(b) Block diagram of input/output request sequence and message input/output processing

Key:

1. Input ENQ sequence
2. In input state, interrupt state reset, setting without substitution
3. One unit of this terminal is a response unit, which accesses byte address tally, the tally is 2
   Main state word isBEAD
4. BEAD connecting word - AC_1
   Major call entrance - AC_3
   Shut off interruption
   Transfer to ordinary queuing ENQUE
5. Output ENQ sequence
6. Set in output state
   Interrupt word F = 5
7. Fill in BEAD word
   Tally 2
   Main BEAD byte address is already at AC

[Key continued on following page]

8. Input one line
9. Interrupt word F is set at 1
   Maximum tally of line is message
   Maximum length is 176
10. Fill in main BEAD word
    Its byte address is the requested buffer zone
    Bud x 2 already is at AC
11. Output one line
12. Fill in main BEAD word
    Maximum output length 176

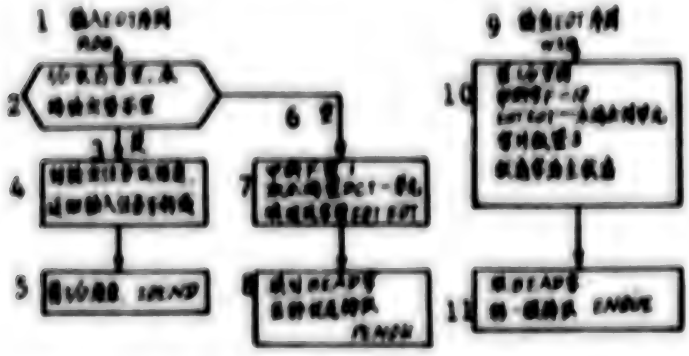
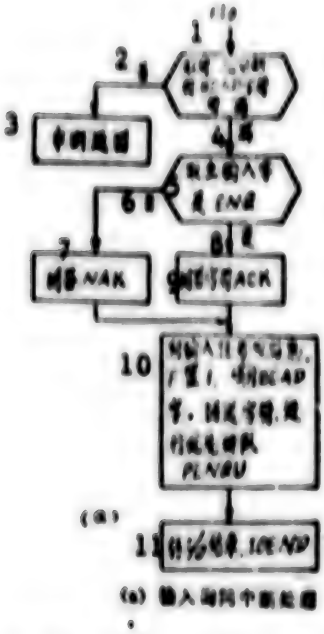


Figure 10. Block diagram of system call processing

Key:

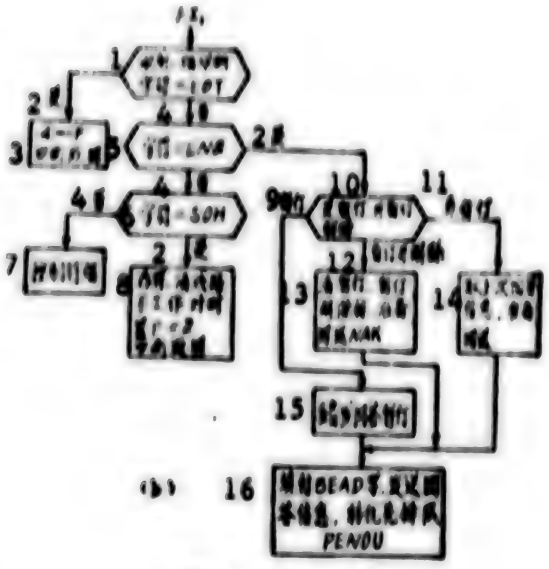
1. Input EOT sequence
2. I/O state begins blank, output of this terminal is not blank
3. Yes
4. Information is transmitted for output task
   Notice is given to input task not to disconnect
5. I/O loop ends, IOEND
6. Blank
7. Interrupt F is set at 1
   Access by this terminal, set DCT unit
   Fill in return transmission character EOT EOT
8. Fill in BEAD word and convert to priority queue PENQU
9. Output EOT sequence
10. Set I/O space
    Interrupt word F = 12
    EOT EOT as shared unit at this terminal
    Word tally set at 5
11. Fill in BEAD word
    . Covert to ordinary queue ENQUE



(a) Processing of input inquiry interruption

Key:

1. Access character. Request interruption
   Press BEAD character
   Character full
2. No
3. Interrupt return
4. Full
5. Access input word is ENQ
6. No
7. Respond NAK
8. Yes
9. Respond character ACK
10. Send information to input task
    F set at 1. Fill in auxilliary BEAD word. Send back character, which undergoes priority queuing PENQU
11. I/O loop ends, IOEND

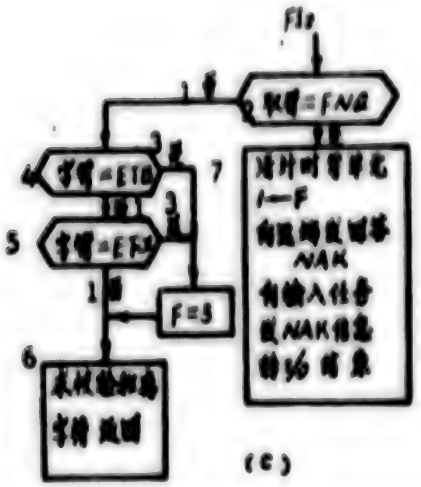


(b) 输入序始中断处理

(b) Processing of interruption at the beginning of input sequence

Key:

1. Access character. Request interruption
   Character = EOT
2. Yes
3. 3-F interrupt return
4. No
5. Character = ENQ
6. Character = SOH
7. Control character error
8. Store character, clear circuit, start non-working timing
   Set F=2
9. Temporary stop
10. Yes temporary stop and temporary stop and cancel
11. Not temporary stop
12. Temporary stop and cancel
13. Clear temporary stop. Flag temporary stop and cancel. Prepare to send back NAK
14. Access responding information of last time. Prepare for sending back
15. Prepare to send response temporary stop
16. Fill in auxilliary BEAD word. Send response information
    Convert to priority queue PENQU

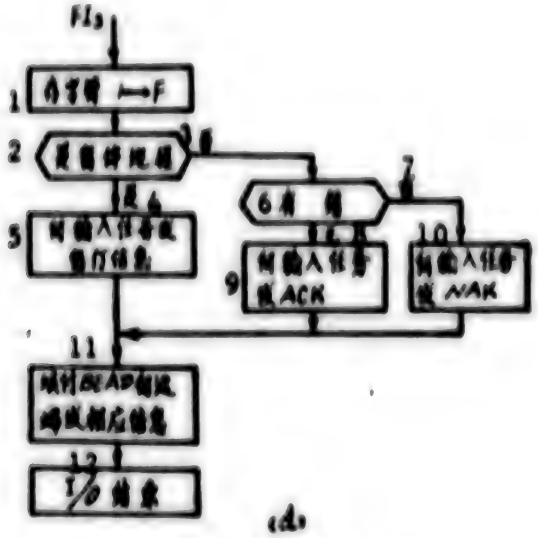


(c) 输入报文中断处理

(c) Interruption processing of input message

Key:

1. No
2. Access character = FNQ
3. Yes
4. Character = ETB
5. Character = EFX
6. Request check and stored character return
7. Clear timing unit etc 1-F
   Send response NAK to far end terminal
   Send NAK information to input task
   I/O loop ends



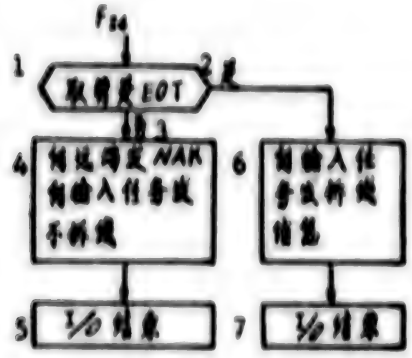
(d)

(d) 输入检错和中断处理

(d) Input check and interruption processing

Key:

1. Stored character 1-F
2. Yes temporary stop procedure
3. No
4. Yes
5. Send temporary stop information to input task
6. Error
7. Error
8. No error
9. Send ACK to input task
10. Send NAK to input task
11. Fill in auxilliary BEAD and send corresponding information to far end terminal
12. I/O ends



(e)

(e) 输入结束中断处理

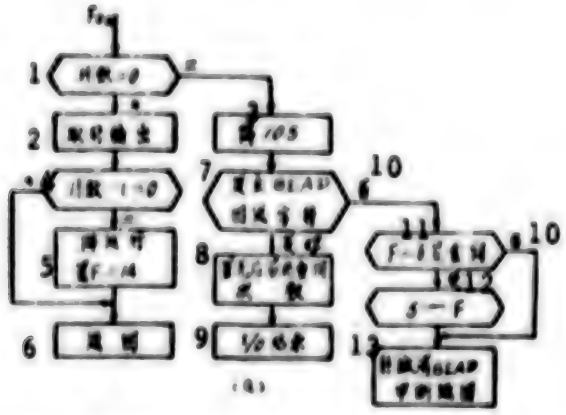
图11 输 入 中 断 处 理 框 图

(e) Interruption processing for input termination

Figure 11. Block diagram of input interruption processing

Key:

1. Access character is EOT
2. Yes
3. No.
4. Send NAK to far end terminal
   Send command not to disconnect to input task
5. I/O ends
6. Send information to disconnect to input task
7. I/O ends



(a)

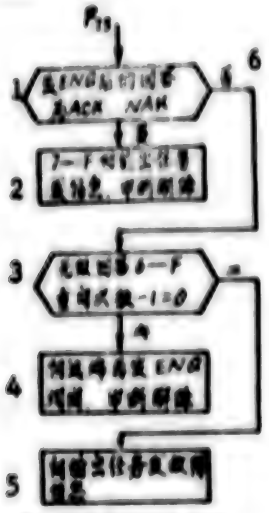
(a) 反向响应序列和输出询问序列

(a) Reverse response sequence and output inquiry sequence

[Key on following page]

Key:

1. Tally = 0
2. Access character output
3. Reduce 105
4. Tally - 1 = 0
5. Reduced operation
   Set F = 14
6. Return
7. Is main BEAD return character
8. Set no response and repeat inquiry times
9. I/O ends
10. No
11. F=6 is repeat inquiry
12. Yes
13. Convert to delete of BEAD
    Interrupt return



(b) 反向重问回答序列

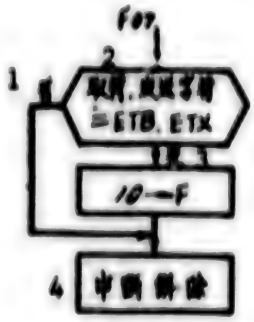
图12 正反向回答序列

(b) Reverse repeat inquiry response sequence

Figure 12. Positive and reverse response sequence

Key:

1. Response after sending ENQ are ACK, NAK
2. 7-F sends information to output task
   Interrupt canceled
3. Ineffective response 6-F
   Repeated inquiry times - 1 = 0
4. Send ENA to far end terminal to enquire again
   Interrupt canceled
5. Send breakdown information to output task
6. No.



(a) 输出正式报文

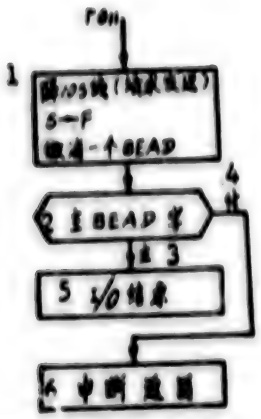
(a) Output of formal message

Key:
1. No
2. Access character. Send character = ETB, ETX
3. Yes
4. Interruption canceled

(b) 输出校验和

(b) Output summary check

Key:
1. Access character output. Summary check set F=14. Return



(c) Termination of transmission of one group of message

Key:
1. Reduce 105 line (request to transmit)
   5-F
   Cancel one BEAD
2. Main BEAD word
3. Main
4. Auxilliary
5. I/O ends
6. Interrupt return

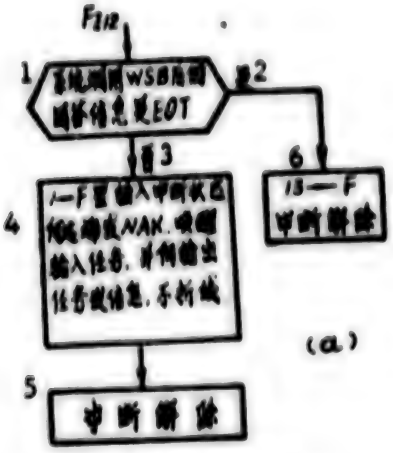
(d)

图13 输 出 中 断 处 理 框 图

(d) Waiting for response from terminal

Figure 13. Block diagram of output interrupt processing

Key:
1. Output complete 1
   Reduce C_{yx} operation trigger set at 0
2. Interrupt return

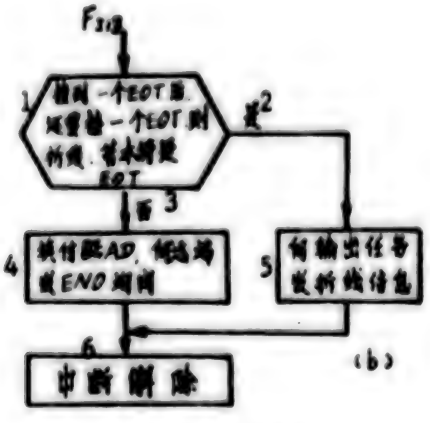


(a) 换向第一字符处理

(a) Processing of first character that changes direction

Key:

1. The response information after system call WSB is EOT
2. Yes
3. No.
4. 1-F is set at input interrupt state
   Send NAK to far end terminal
   Call up input task
   Send information to output task
   Do not disconnect
5. Interrupt canceled
6. 13-F
   Interrupt canceled



(b) 换向第二字符处理

图14 换向处理框图

(b) Processing the second character that changes direction

Figure 14. Block Diagram of processing of changes in direction.

[Key on following page]

The above are block diagrams of programs related to communications procedures. The other block diagrams are not shown.

II. Control Program for Data Exchange Between the Main Frame and the Front Communications Processor

The DJ8-6 main frame computer lacks a more suitable supervising program. Most of the units at present use the ALGOL-60 two page compilation. Some use FORTRAN compilation. Therefore the software is insufficient and the processing capabilities are not strong. To start out from present conditions, revisions and supplements are added to the present software to adapt to the requirements of the network. The entire structural form of the ALGOL-60 two page compilation is kept. Only the parts concerned with supervision and service are rewritten--into a program subsidiary to the ALGOL-60 compilation program so that data exchange between the main frame and the front machine can be satisfied.

1. Functions

Because operations must follow the procedures of ALGOL compilation entirely, and because the main frame regards the front machine only as a kind of I/O equipment, therefore it completely controls data exchange.

(1) To adapt to far end terminal operations, a new interruption processing function has been added.

(2) Information input control and processing functions: According to the needs of the compilation system, when a certain information is wanted, the type of the needed information is output to the front machine. This initiates the front machine to input the corresponding information and processes it and recognizes it to satisfy the requirements of compilation.

(3) Command processing function: According to requirements, several commands have been added to the original commands. Commands coming from the end terminals are channeled into "man-machine" conversation and the related information is sent to the front machine and processing of various commands is immediately carried out.

(4) Information that needs to be output undergoes a change of codes, processing and write-up according to the requests of the end terminal and is then sent to the front machine.

(5) Retaining the functions of all original standard processes.

After collating, the terminal machine now is completely equipped with the capabilities to use the various functions of ALGOL-60 of DJ5-6 to carry out computations. At the same time, because the data exchange channel is connected to the front machine, not directly connected to the I/O equipment, the operation time is greatly shortened. The work efficiency of the main frame is elevated.

2. Structure

The structure of the ALGOL-60 two-page compilation program of the DJS-6 computer is basically retained. The original service program is deleted, and a new interruption processing program, the I/O and command processing program, and a standard processes program are newly written and put in place. Only the structure of the newly compiled parts are explained in the following:

(1) Interruption processing

The input and output equipment on the DJS-6 computer are masked (not necessary) to raise the utilization efficiency of the main frame machine. This specifically processes data exchange interruption between the front machine and the main frame. In input interruption, there is still the need to decide what type of input information it is and to channel it for corresponding interruption processing. After interruption processing, it is returned to the interrupt point.

(2) Input/output processing and command processing

An input type mark is set up according to the condition of program execution. Generally it is a "teletype type," this means it waits for the command form. When the command is input, the commands are differentiated. Different commands are channeled into corresponding command processing programs. All types of work proceed according to the order and the content of the commands. If certain information is needed in the processing, an input type mark is given. This initiates the front machine to input. Then the input is correspondingly processed. After one command has been processed it waits for the next command.

Output information undergoes character writeup, format processing and corresponding processing based on the output type--fixed point or floating point data, data control, format and the type of output equipment and actual conditions. Then it is flagged by a certain mark and output to the front machine so that it can be directly output on the various terminal equipment.

(3) Standard processes

The various original standard processes have also been correspondingly treated so that the machine can be used normally and the structural composition remains unchanged.

Conclusion

At present, this network is still in an experimental stage. Further practical applications are needed. The DJS-130 computer as a front communications processor should be further perfected. It is entirely possible to use it as a node machine in a computer network.

The photographs of this experimental system of a computer network are shown on Cover 3.

9296
CSO: 8011/1344

DJS-140 COMPUTER, ITS SOFTWARE INTRODUCED

Shenyang ZHONGXIAOXING JISUANCJI [MINI-MICRO SYSTEMS] in Chinese No 2, 25 Apr 80 pp 12-18

[Article by Zhu Jisheng [2612 4949 3932] of the Beijing Computer Plant No 3: "The DJS-140 Computer and Its Software"]

[Text] Abstract

This article gives a relatively systematic introduction to the various systems software of the 140 computer, from the operating system, computational language, service programs, to the characteristics and applications of the various kinds of programs and program packages. It is a general description of the 140 computer system for those who wish to understand the 140 computer system or those users who wish to purchase the computer.

1. Brief Introduction to the Functions of the 140 Computer

1. The DJS-140 computer is the first rank computer of the 100 series computers produced domestically

It is one of the computers along with the DJS-110, DJS-120, DJS-130 that comprise the 100 series computers. The 140 computer possesses the following characteristics:

(1) Serialized design of products

Serialization of products realizes standardization of command systems, program language, data format, character coding, interrupt system and channel interfaces, thus assuring upward compatibility of the series of products. The user can conveniently change or expand his own original system.

(2) It possesses a small size and has multiple functions

The system is suitable for medium and small size scientific and technological computations and also in an outstanding real time system which takes into consideration the ever increasing needs of controlling real time processes and data processing. Thus it has a wide range of applicability.

(3) It possesses a high reliability

Because of common design of the entire computer and its components and mutual progress, an entire set of TTL medium scale integrated circuits (totaling 14 kinds) has been developed. This has elevated the stability and reliability of the 140 machine. The degree of integration of the medium scale integrated circuit of the 140 computer is 4 to 10 times that of the small scale integrated circuit of the 130 computer. The elevation of the degree of integration has also lessened the bulk of the main frame machine and has made it more convenient to debug and maintain the machine.

(4) The ratio between function and price of the system has been elevated because of the close combination of hardware and software design and unified design. For example, storage supervision and protective functions are realized by means of a combination of hardware and software.

(5) The 140 computer possesses a building block structure

Internal storage, operational control, peripheral and software all possess a building block structure. For example, the system's smallest combination can include on the CPU main frame, a 16K internal storage, a magnetic disk with an active head and a console typewriter, a paper tape input device (this is the smallest combination and the cost is only about 200,000 yuan). Its largest system can include as many as 15 computers forming a multiple computer system. Each machine can be expanded to include 61 peripheral equipment, with 128K internal storage, and include a floating point computation component, storage supervision and protective components. The system allows the user to form systems of different scales according to his own need.

(6) It possesses a rich and perfectly complete software system

This takes into consideration the fact that small computers are oriented mainly towards applications. The 140 computer does not insist on possessing the most advanced hardware but its main purpose is to possess as many software systems as possible.

2. Major Hardware Specifications

Basic word length: 16 digits
Basic commands: 22
Basic expandable commands: multiplication, division, clearing A, and 11 control commands

Selective expandable commands: 34 floating point commands, and 10 commands for internal storage supervision and protective components.

(1) The central processing unit CPU:

It has four 16-digit word length accumulators, two of which can be used as index registers. The 140 computer possesses the capability of affecting a data channel request during the process of executing a command (the 130 computer cannot). The longest waiting time is 1.5 μs. To adapt to the needs of real time tasks, the system provides channel plus "1" and channel add functions to complete the tasks of probability statistics and accumulation of physical quantities in real time. This will provide an important means for real time processing. The CPU includes automatic guies for 32 commands and components for re-start up after a power failure. Fixed point computations (+ - x $\div$) average 500,000 to 700,000 times/second.

(2) Floating point unit FPU:

This is a selective component. It can perform single precision 32 digit (equivalent to effective numbers of 6 to 7 digits in the decimal system) and double precision 64 digit (equivalent to effective numbers of 14 to 15 digits in the decimal system) floating point numerical computations. The numerical range is between 5.4×10^{-79} and -7.2×10^{75}. The average speed of floating point computations is 30,000 to 50,000 times/second. At the same time, the FPU can also be connected to the main frame CPU serially or parallelled in operation.

(3) Internal storage supervision and protective component MMPU:

This is also a selective component. It is also called multiple channel program component. It can expand the internal storage of addresses of the main frame from 32K words to 128K words. This provides the hardware basis for multiple channel program operations. In this way the logical addresses of the user operation is changed to actual addresses and the internal storage is supervised by the page (one page = 1024 words). At the same time, to assure the reliable operation of multiple channel programs, it also provides various error checking and protective functions. This means it can check odd-even errors of the internal storage, it has the protective function of closed writing, it can check the addresses, inquire cross boundary errors, inquire address inquiry errors and prevent users from directly using peripheral equipment.

(4) Main storage unit: It uses a triple three-line current coincidence magnetic core storage unit (the size of the magnetic core is 0.56 mm x 0.33 mm x 0.15 mm). It also uses an 8K word block board structure with maximum internal storage capacity of 128K words. The storage cycle is 1.3 to 1.6 μs.

(5) Peripheral equipment

It uses the input and output bus and standard peripheral interface. It has a 16-level hardware interrupt priority selection system. At the same time the software can change the priority levels of interruption of each equipment. Slow speed character (input and output) equipment uses program interruption. High speed magnetic disks and magnetic types use data channels for direct access of internal storage to transmit data. The bus has 61 kinds of equipment codes for the user to equip it with various kinds of peripheral equipment and expand the command system. The 140 computer has the following accessories: Loadable and unloadable 14-inch active head magnetic disks with a capacity of 5 MB and a speed of revolution of 2400 revolutions/minute, vacuum integration band box or pendulum type half-inch magnetic type device, 8-unit console typewriter and character display, paper tape input device and puncher, 80 or 132 line printer, numerical plotter, real time clock and a converter capable of being equipped for asynchronous multiple path communications with 64 terminals.

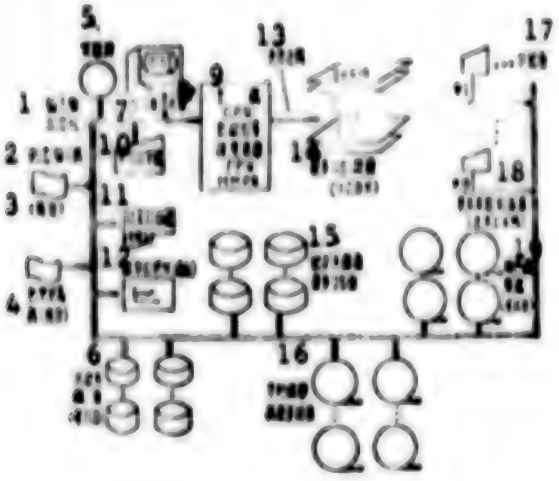


图 1 140机硬件系统

Figure 1. Hardware system of the 140 computer

Key:

1. Input, output bus
2. Paper tape input device
3. (Two machines)
4. Paper tape puncher (Two machines)
5. Real time clock
6. Active head magnetic disks (may be as many as 8)
7,8. Character display
9. Main frame CPU
   Augomatic guide
   Lost power start

[Key continued on following page]

10. Teletypewriter
11. Line printer (may be two)
12. Simulated world plotter (Two)
13. Internal storage bus
14. Maximum 16 boards (128K)
15. Fixed head magnetic disk, maximum 16
17. Total 4 units
18. Asynchronous multiple path converter (total 64 lines)
19. Kiskette decks (may be as many as 16 units)

Table 1. Various Software of the 140 Computer

[Key on following page]

Key:

1. Software system of the 140 computer
2. Operating system
   MRDOS real time magnetic disk operations sytem for internal magnetic tape supervision components
   RDOS real time magnetic disk operating system
   XRTOS real time operating system
   SOS independent operating system
3. Operations supervision programs
   CLI keyboard command explanatory program
   BATCH processing program
   This program can only be used when input is punch cards
4. Computational Languages
   Expanded assembly
   Macroassembly program
   Single user basic BASIC
   Time shared BASIC
   Expanded single user BASIC
   Expanded multiple user BASIC
   Real time FORTRAN IV
   Real time FORTRAN V
   Expanded ALGOL-60
5. Service programs
   DEB II error checking program
   IDEB IV error checking program
   Original document editing program
   Octonary editing program
   Stored documents editing program
   Magnetic disk editing program
   Duplicate paper tape program
   Floating load program
6. Program storage packages
   Floating point explanatory program package
   FORTRAN operations program storage
   DATA PLOT data plotting processing program package
   Buffer input and output program package BFPKG (in the following it is backup)
   Scientific computations program packages NSPI NSPII
   Discrete Fourier Transform DFT
7. Checking and diagnostic programs

II. Software of the 140 Computer

The 140 computer is equipped with a multiple operations sytem, computational languages and service programs. These include SOS, XRTOS, RDOS, MRDOS operational systems, floating assembly, macroassembly, expanded ALGOL-60, expanded BASIC, real time FORTRAN IV, real time FORTRAN V computational languages and error checks, various editing programs, program storage and program package. See Table 1.

The various kinds of software all have an explanation booket stored on paper type, magnetic type and magnetic disks, forming a complete software system for the 140 computer.

1. Operational System

The four operational systems of the 140 computer, SOS, XRTOS, RDOS, and MRDOS are all upward compatible. The SOS system possesses a simple and easy-to-use characteristic. It is actually only a slow speed I/O basic equipment supervision program. It can control and supervise the teletype (it includes TTR, TTP, TTI and TTO equipment) paper tape input device, line printer, card machine, puncher and plotter as the six basic peripheral equipment. One important aspect is that it can be connected to the various computational languages of the system and possesses the capability of supervising these basic equipment using such languages as expanded BASIC, 12K basic FORTRAN IV and ALGOL-60. The resulting commands generated by these languages are given in the form of call commands of the SOS system of symbol assembly commands. Actually this connects the various languages with SOS, the assembly program and the floating assembly program to form a software system under the control and supervision of SOS. The SOS system also expands the supervision of the magnetic tape device and provides the user the ability to use the magnetic tape device and system's document storage. This has improved the efficiency of the system and has provided conveniences to the users.

The XRTOS operational system is a permanent and internally stored high speed general purpose real time and multiple task system. Consideration has been given to satisfying the needs of various users and the most fundamental and necessary functions of the majority of users have been designed into the system. Therefore, its structure is simple yet strongly adaptive. It is very easy to use it as the basis for writing various types of specialized system software. (1) The XRTOS system has realized the supervision of input and output from many types of I/O equipment (including supervision of basic I/O equipment, QTY multiple path communications converter and magnetic tape and magnetic disks), and possesses the function of utilizing the I/O equipment to call up documents. (2) It has provided a multiple task system. (3) It is structurally speaking a modular XRTOS system and is a complete and permanently and internally stored program. It possesses a repeated entry structure. (4) Consideration has been given to the high speed responses to special interrupt requests required in real time tasks. The system also provides a high priority processing interface for the user. (5) The computational languages supported by the system are real time FORTRAN IV, expanded BASIC and ALGOL-60.

An important operational system of the 140 computer is RDOS, the real time multiple task magnetic disk operational system for two-track operations. It includes all functions of the XRTOS and SOS operational systems. It also has additional functions of multiple user masking, foreground and background processing, magnetic plate partition and sharing processes,

document supervision and operations processing, high speed buffering of input and output of peripheral equipment, exchange and linking processes, and pseudo-off line processing.

The so-called two-track operation is simultaneously allowing the storage in the internal storage of two different user operation programs (separately called the foreground operation and background operation). These two operations can operate simultaneously and compete for the CPU. For example, the foreground operation can process real time multiple tasks while the background can process operational programs that do not have a strong demand for real time. For data communications of two-track operations, the system provides means for the transmission of data via a special communications zone between the foreground and the background programs. In addition, both the foreground and the background programs can invoke the magnetic disks for documents and the directory.

The RDOS system provides the user with a real time multiple task system, including the establishment of each task, parallel processing of multiple tasks and calls, communication between tasks, competition, synchronous operations, information exchange and task delays, and supervision of the real time clock.

To effectively utilize the various equipment resources of the system, the system has set up various systems procedures (CPU procedures, procedures of each peripheral equipment, foreground and background operations procedures and pseudo-off line procedures) to realize parallel processing between the main frame and peripheral equipment and among the peripheral equipment. The introduction of the pseudo-off line procedure in RDOS has changed the output of the slow speed character equipment into a reading and writing procedure of high speed channel equipment. It uses the magnetic plate as its output buffer, thus elevating the operating efficiency of the system.

The RDOS document system provides the user with split level supervision (first level region, second level region and sub-directory) and various access schemes (line scheme, sequence scheme, random scheme), and three kinds of document structures (continuous documents, random documents and serial documents). The system also regards all peripheral equipment as documents. In this way, the use of simple document reading and writing commands is sufficient to execute input and output on the equipment. The system provides continuous inquiry of the subdivisions of the magnetic disk, the sub-directory and documents, document sharing and document protection. This has created a convenient condition for the user to independently use the documents in the magnetic disks (each user can use his own subdivision and sub-directory) and for the users to use certain public documents in the system together. These functions of the document system strongly support the operating system.

The system provides user masking and exchange linking techniques for the user in an effort to expand the storage capacity of the 140 computer. RDOS allows a maximum of 128 masked regions. Each masked region can have a maximum of 256 masks. The system provides the user with convenient user masking commands and call masking commands. The user masks are suitable for use in multiple task systems. Each task can share the same masked document. Exchange enables one to write into the magnetic disk the program information in the internal storage in document form. The program to be called is read into the internal storage from the magnetic disk. The control is turned over to the calling program. When the execution of the called program is complete, it is returned to the original call program via the return command. This can be viewed in a broad sense as a revolution and return. RODOS allows the exchange and return at a maximum of five levels. Linking and exchange are different. Here, it can be understood as a jump in the broad sense. This is because it does not need to retain the program information and thus linking is not limited to the number of layers. With the exchange, linking and masking processes, the RDOS system greatly expands the storage capacity of the 140 computer. The 140 computer placed in front of the user is a virtual computer with an unlimited virtual storage space. They have solved the conflict of running a relatively large program on a machine with a relatively small storage.

RDOS has also designed an interactive conversational chain disk command language--operational control language. It supervises controls and calls the various resources of the computer, its own operating program and document information using the keyboard commands via the control console typewriter or the character display. The machine, via corresponding output equipment (mainly the output equipment of the console) responds to the condition of execution of the commands keyed by the user or provides certain information required by the commands. That language is the boundary surface between the RDOS and user using the console as the medium.

To assure the reliability of the real time system, the RDOS system has designed the major service means necessary for the operation of two computer systems, such as the means for switch-over between two machines (this is, to switch the operating system from the erred machine via the master clock to another computer for continued operation), synchronization and communication between two machines and the sharing of magnetic disk documents by two machines. With these means, the user can establish their own functions for duplex and dual machine operations or dual machine and dual processing according to the requirements of the actual task and actual conditions. The dual machine system of the RDOS system is based upon the consideration of connecting the hardware of two machines of the same model of the 140 computer. Therefore it does not require any changes in any piece of hardware of the main frame. Only a dual machine hardware needs to be attached to the original system. Thus a user having one 140 computer can easily expand his system into a dual machine system. At the same time, the software also takes into consideration the common use of the dual machine operating system and the single machine operating system.

The system uses the operating method of the dual machine and dual operating system, and it does not use one operating system to supervise the operation of the dual machines. Thus the serial character and the building bloc character of the hardware and the software of the 140 computer are assured.

The RDOS system supervises the various system processing software and service programs. They expand the single user, the multiple user BASIC, real time FORTRAN IV, and real time FORTRAN V languages, ALGOL-60, the programs that check errors, original text editing, octonary editing and the storage document editing programs. All of these software form a complete set of RDOS software system.

The highly modular structure of the RDOS system provides the user with the ability to expand from the smallest system of one 128K magnetic disk, a 12K internal storage and one teletype to a complex system of 8 active disks and 16 fixed disks with large peripheral storage as a backup storage. This type of versatile building block structure makes it possible for the user to compose his own operating system according to his own need and the amount of his actual equipment and the original system can be expanded anytime and anywhere. The same user can even be permitted to form several operating systems of different users and can switch over to any one system at anytime.

The 140 computer has been equipped with another important operating system, the MRDOS system. This is a system that cannot be equipped on the other models of the 100 series computers. It is a real time multiple task magnetic disk operation system capable of two-track operations with storage supervision and protection. It includes all the functions and characteristics of the RDOS systems, and expands the function of supervision and protection of the storage. The MRDOS system is completely oriented towards the multiple program environment. We know multiple channel programs are designed as a software technique to elevate the rate of utilization of a system. At the same time it also makes a higher demand upon hardware resources. The first demand is that a larger storage space is needed to store the multiple channel operating programs. The RDOS system only provides 32K internal storage space and it cannot solve this problem. The storage supervision and protection components under the supervision of the MRDOS system expands the internal storage of the main frame of 32K to 128K. Each operational program is provided with a 32K storage space.

To assure the safe and reliable operation of each operation, the system provides storage protection for each operation.

To prevent certain important programs or data from being accidentally invoked and destroyed during user operations, the system provides the function of closed writing page. The programs in storage can be read but cannot be written. This also provides the condition for the common use of certain stored data or programs for multiple tasks.

The MRDOS also provides the function of checking errors of user operations, intermediate addresses and wrong inquiries (a continuous inquiry of an intermediate address over 16 times is regarded as a dead loop), and block assigned I/O equipment. This is to prevent the user from directly using the I/O commands of these equipment to make inquiries, and check on any odd-even checking error in the internal storage.

To enable the data channels and the main frame to operate simultaneously under the component of storage supervision and protection, the system has provided separately for them a data channel map and a CPU address map. These two maps can simultaneously provide the function of address change for channel inquiries and main frame inquiries of the internal storage.

The MRDOS system has an even greater advantage than the RDOS system. It provides supervision and call functions for each channel of operation to facilitate operation. In the MRDOS system, the user can establish separately two keyboard command languages: the foreground keyboard command language and the background keyboard command language. In this way the foreground and background users can simultaneously operate their own operations under the control of their own keyboard command languages. For example, when the foreground keyboard commands are given in FORTRAN for multiple task compilation operations, the background can simultaneously give keyboard commands for compilation operations using the multiple user expanded BASIC system, unlike RDOS in which two-track operations can be run only under the control of one keyboard command language. This actually changes one 140 computer into two 140 computers. Two users can simultaneously via two control console typewriters or character displays give keyboard commands to use two virtual 140 computers each having 32K of internal storage. If each channel operation is a multiple task system or a multiple user BASIC system, then each virtual computer becomes a virtual computer or terminal possessing many parallel processing capabilities. It can be said that the MRDOS system is a system possessing the greatest rate of utilization of system resources and greatest rate of system operation among the machines in the 100 series.

The operating system changes the 140 bare computer with only 22 commands into a virtual computer having an operational system with much stronger functions and with many more commands by providing the user with various system commands. The instructions and commands of each operating system provided to the user for use are listed below:

	1	2	3	4	5
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 2. Comparison of the various operating systems of the 140 computer

Key:

1. Machine commands
2. Task commands
3. Systems commands
4. Keyboard commands
5. Total

The functions of each operating system are different. The demands upon the equipment are also different. The SOS system requires 4K words of internal storage for operation. The XRTOS requires at least 8K words of internal storage and a teletypewriter and real time clock. The smallest combination of hardware for the RDOS is 12K words of internal storage, 128K-word magnetic disk and a teletypewriter. The MRDOS requires at least 16K words of internal storage, 128K-word magnetic disk, a teletyperwiter and storage supervision and protective components (MMPU). Therefore, when the system combination has the MMPU and the magnetic disks, the MRDOS system can be operated. When the system is not equipped with MMPU but is equipped with disks, it can operate the RDOS system. When it is not equipped with magnetic disks, it can operate the XRTOS or the SOS systems.

2. Language System

The 140 computer is equipped with computational languages including BASIC, FORTRAN and ALGOL-60.

BASIC includes single user basic BASIC, time shared BASIC and expanded BASIC. Basic BASIC is the simplest interactive conversational language. It possesses simple keyboard commands and statements that facilitate computation and operation (they can be input on the keyboard).

The functionally perfect expanded BASIC system includes all functions of basic BASIC and time shared BASIC. Its major expanded functions are:

(1) It greatly increases keyboard commands, especially supervising commands of operation, input/output commands for documents and directory supervision commands. These facilitate use by the users.

(2) It expands the functions of basic statements, such as switching statements and call assembly statements. It increases the statements for matrix computation and matrix input and output that facilitate data processing, statements for serial computation for characters and statements for automatic selection of the format for the output printer.

(3) Expanded BASIC provides a strong capability for time shared processing. It is a BASIC system that can be used by as many as 32 local and distant terminal users simultaneously. This fully develops the operating efficiency of the main frame and also facilitates use by users. Each user believes he is continuously using the computer solely and he can disregard the presence of other users.

The expanded BASIC system is modular in structure. It can be composed into BASIC systems of different scales according to need. This includes the single user expanded BASIC, multiple user expanded BASIC and the multiple user expanded BASIC that uses the internal storage alternately (this system requires a fixed head magnetic disk). At the same time, the expanded BASIC system can be combined with the several operating systems above and different BASIC systems can be operated under the support of each operating system (above).

Syntactic analysis of the explanatory system of expanded BASIC uses the state matrix method. The entire BASIC grammar has 209 states processed uniformly by one state analysis program.

The system uses cyclic time sharing of a time slice to carry out time sharing supervision for each terminal user. Each time slice is 160 ms. In this way, a better response time can be realized.

The function of the time shared BASIC system is between those of the expanded and the basic. The expanded BASIC system becomes the time shared BASIC system when the input and output of documents, directory supervision and automatic selection of output format functions are eliminated. At present, time shared BASIC has been basically replaced by expanded BASIC.

FORTRAN IV and FORTRAN V language

These two FORTRAN languages under the control of RDOS and MRDOS of the 140 computer both possess a real time multiple task system. They also include all the standard text regulations of ANSI FORTRAN of 1966, and have expanded these somewhat, including double precision real number, complex number and mixed computations, complete real time multiple task systems and supervision systems for each peripheral equipment, magnetic disk directory and documents. They also possess the ability to combine with the assembly language, further elevating the operating efficiency of the system. Real time FORTRAN V not only strengthens the basic functions of FORTRAN statements but also uses many means to better the quality of the object program so that the quality of compilation is comparable to the assembly program.

its compilation program improves processing of FORTRAN statements and between statements, such as one time compilation of the same expression for multiple use, and removal of expressions that are not affected by cyclic variables in a cycle. Cycles and expressions are improved in processing. FORTRAN V has become the major computational language being used on the 140 computer. Its operation requires at least 40K words of main storage (operating under MROOS), and magnetic disks, magnetic tape and a floating point unit (FPU). FORTRAN V uses parallel operation of the FPU and the main frame CPU giving its object language the characteristic of parallel operations, and thus elevating the operating efficiency of the program.

The expanded ALGOL-60 computational language has the following major expanded functions:

(1) It expands the line variations of the characters, digital operation and character line operation and their basic functions. It also expands computations of complex numbers and multiple precision data computations. Multiple computation can handle a maximum of 15 machine words, assuring the effective value of 60 digits in the decimal system.

(2) It provides functions for the establishment, deletion and editing of documents and such functions of free format reading and writing of routine I/O programs, random reading and writing and format output.

3. Assembly Programs and Service Programs

The 140 computer possesses a floating assembly program and a macroassembly program. The floating assembly program assembles a floating object program. It can combine the load program with other programs and store them in the internal storage at any position. The floating assembly program also provides mutual use of variables, names and constants between different program segments. In addition, it also has various conditional assembly statements for the user's debugging programs.

The macroassembly program further expands the following functions on the basis of the floating assembly.

(1) Computation of expressions possesses priority order.

(2) Certain sections of the program can be repeatedly assembled.

(3) It increases macrodefinition. The user can set up a section of a program which is repeatedly used and which possesses a certain function as the macrodefinition of some variable parameters. Then it can be called at will within one's own program (macro call). This greatly expands the functions of the assembly program.

The original text editing program, the octonary editing program and the stored document editing program separately provide the functions of editing, processing, combining and revising ASCII source documents, octonary object documents and stored documents.

The debugging and error checking program of the 140 computer has two kinds of error checking routines: One is the symbol error checking routine III that allows interruption and the other is the error checking program that does not allow interruption. They provide interrupt points for the user to debug his own program and functions for the selective printing of some information, revision of information and executive functions to supervise and control user programs via specially assigned instructions and data search functions.

Loading program provides connection and loading of each program. It can load several floating binary documents and stored documents to form retained documents that are executable. User masks can also be created using the loading program.

The above assembly programs and service programs can all operate under various operating systems. The following two service programs are provided in the absolute binary form and can be used independently.

Duplicate paper tape program can duplicate any type of binary paper tape and check the accuracy of new duplicate paper tape.

Magnetic disk editing programs can be used to directly revise or restore certain information in the magnetic disk directory, and thus restore magnetic disk documents that have not been destroyed.

4. Checking and Diagnostic Programs

To coordinate with the debugging and maintenance of hardware, the 140 computer is equipped with various kinds of checking and diagnostic programs. These programs can help the debugging personnel search for breakdowns and conduct mistaken positioning accurate to the component that has broken down. The checking and diagnostic programs of the 140 computer includes: The CPU logic diagnostic program, arithmetic checking program, multiplication and division components checking program, the internal storage checking programs I, II, III, basic peripheral equipment checking program, comprehensive practice checking program, power source, power failure and start-up and restart-up checking program, teletypewriter checking program, paper tape input device checking program, paper tape puncher checking program, character display checking program, numerical plotter checking program, wide line printer checking program, real time clock checking program, internal storage supervision and protection components checking program, QTY multiple path device checking program, floating point computation components checking program, active head magnetic disk logic diagnostic program, active head magnetic disk

reliability checking program, fixed head magnetic disk logic diagnostic program, fixed head reliability checking program, miniature magnetic tape device logic diagnostic program, miniature magnetic tape device reliability checking program and multiple I/O equipment reliability checking program.

III. Program Storage and Program Package

The 140 computer has been equipped with the floating point explanatory program, FORTRAN operating program storage and data plotting process program package (DATA PLOT), and preparations are underway to equip it with other kinds of applicable software and program packages.

1. Floating point explanatory program package

It provides the capability of various operations and computations requiring floating point numbers via software in cases where a floating point computational unit (FPU) is not available.

2. FORTRAN operation program storage

It provides a complete set of subroutines for the various data format of FORTRAN, the multiple computations of character strings and the multiple task systems used by documents, equipment and directories.

3. Data plot processing program package

It provides a series of standard subroutines for the system to use the plotter for plotting coordinates, origins and lines.

4. Buffer Input/output Program Package

It provides for the use of the buffer processing method to raise the I/o equipment's processing efficiency. The various types of switch-on commands, reading and writing commands and switch-off commands provided by that program package can replace the commands for reading and writing documents in RDOA and MRDOS, and they provide a higher processing speed.

5. Scientific Calculations Program Package I, II

This is a standard subroutine for frequently used computational methods in many scientific, technological and engineering calculations. The NSPI includes 10 standard routines for all kinds of matrix computations, ordinary differential equations, numerical differentiation, and numerical integration. NSPII includes 12 routines for multiple regressive analysis, correlative analysis and various statistical analysis programs.

6. Discrete Fourier Transform (DFT)

This is a data processing method frequently used in scientific and technological computations. This program package provides the subroutine for this method of computation via software.

IV. Applications of the DJS-140 Computer

The DJS-140 computer is a small sized, multi-functional, general purpose electronic digital computer. It is suitable for applications in various real time process controls and medium and small sized scientific and technological computations.

1. Real Time Process Control

To adapt to the needs of real time processing, the 140 computer has been designed with a real time clock with various time frequencies and data channel response capabilities during the course of executing commands. The channel plus "1" and the channel plus functions of the 140 computer have provided important means for performing probability and statistical computations during data collection in the course of real time processing. All software of the 140 computer are oriented towards real time application systems, such as real time FORTRAN and real time operational systems. The 140 computer can be equipped with DA and AD converters and a procedural input/output system which can monitor, control and supervise production procedures.

2. Scientific and technological computations

The floating point component of the 140 computer can perform computations involving effective numbers of 14 to 15 digits in the decimal system. This basically satisfies the requirements of ordinary engineering, scientific and technological computations. The 140 computer also provides the user with several computational languages which are more frequently used, such as BASIC, ALGOL-60 and FORTRAN. The scope of the software systems for the 140 computer is not large but is representative. Therefore, they are suitable for educational use by various higher educational institutions to establish computer centers. At present, many teaching materials of the computer majors of the science and engineering departments throughout the nation's educational system have been written according to the software of the various systems of the 100 series computers.

3. Data Processing.

The large capacity magnetic disks and magnetic tape storage systems of the 140 computer has become the medium for storing large amounts of data and documents. The documents system and its related programs can collect, store, transmit, classify and output various kinds of data. The system can also provide supervision programs and software package corresponding to asynchronous multiplex devices and far end terminal users to realize real time or time shared supervision for the user of the terminal.

4. Diagrammatic Processing

The 140 computer is equipped with graphic output equipment such as the digital plotter and the corresponding software (such as DIAT PLOT program package). The 140 computer can process many kinds of graphs.

5. Multiple Computer Systems and Networks

The 140 computer is equipped with a machine-machine bus drive which can provide dual machine and duplex functions of dual machine and dual processing functions between two 140 computers. The two computers can operate independently while using one magnetic disk together. This is a setup in which two machines share the magnetic disk and whereby the two machines can communicate with each other between programs. When one computer breaks down, the other backup computer takes over the operations and continues the work. The two machines may also share the burden of the work and operate as dual processors. All of these can elevate the reliability of the system or expand the processing capabilities of the system. The communications converter for a multiple computer system of the 140 computer can connect and communicate among as many as 15 computers, forming a multiple computer system. The 140 computer can also be equipped with special interface and corresponding program packages for linking with computers of the IBM series. This makes it easy for one 140 computer to expand into a multiple computer system or be linked to a computer network.

At present, the 140 computer is being manufactured in batches by the Beijing Computer Plant No 3, Jinzhou Radio Plant No 2 and the Liaoyuan Radio Plant No 3.

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CHINESE CHARACTER INPUT METHODS

Shenyang ZHONGXIAOXING JISUANJI [MINI-MICRO SYSTEMS] in Chinese No 2, 25 Apr 80 pp 61-69]

[Article by Jin Hufan [6855 5706 5400] of the Shenyang Computer Institute of the Chinese Academy of Sciences:

[Text] At present, the electronic computer is being widely used in various sectors of the national economy. It has even expanded from traditional numerical information processing to non-numerical information processing. Especially in the Chinese character information processing systems, there is an urgent need to use the computer for direct processing of Chinese character information. Therefore, the development of a kind of simple and reliable, high speed Chinese character input device has become a very important topic for the Chinese character information processing system.

Foreign nations have begun the study of Chinese character input devices relatively early and have developed various types of Chinese character input devices. Especially in Japan, the application of this type of devices is wide. Based on the working principles, Chinese character input devices can be generally divided into two kinds: One kind is to send codes representing the characters (recognized by the number of digits and design of the character) into the information processing system. The other type does not involve recognition of codes. Only the information on the diagrammatic form of the character is sent into the information processing system for recognition. Table 1 shows the types of Chinese character input devices. In the table, the keyboard entry type and the positional type of input belong to the first category. Character form recognition belongs to the second category. In the following, these methods of Chinese character input are separately introduced.

I. Keyboard Entry of Chinese Characters

Like numerical and alphabetic systems, keyboard entry of Chinese characters is still regarded as the basic method at present in Chinese character information processing systems. There are generally two types: One is the full keyboard type and the other is the ordinary keyboard type.

1. The Full Keyboard Type Chinese Character Input

This method is to represent all the characters needed directly on a character board (ordinarily between 2,300 and 3,000 characters). It has a history of over 20 years of being used for long distance communications by newspaper agencies and automatic movable type casting. At present it still occupies the leading position. Although the structures of the devices are not the same, the working principle is very easily grasped. There are three types of structures: (1) ordinary typewriter structure; (2) an assembly of 625 keys on a board, each key represents four characters, each character is selected by a shifting system of two foot pedals each with two shifts; (3) an assembly of 192 character keys on the board, each key selected by the right hand represents from 12 to 16 Chinese characters, and the left hand operates 12 to 16 keys.

The above devices mostly use the typewriter keyboard to punch two rows of codes (12 to 16 digits) on a paper tape to represent each character. Some also use punch cards with 80 columns and punch holes in two columns to represent the characters. The character codes are generated in two ways:

(1) One is to use movable types like those on an ordinary typewriter. A design representing the character codes is placed at a certain position on the movable type. Between the time the Chinese character is entered and printed, an optical method is used to read that Chinese character's code. Table 1 shows the movable type and the code used by the FACOM 6805A Chinese character punch card machine.

It can be seen from the diagram that the code is composed of 30 marks. Line a represents the command to begin, the remaining lines represent the code, each line's fifth row a_5 to e_5 is the odd-even checking digit. The light ray that reflects the code moves along with the movable type from line a to line b, .. line c,,,,,, etc, taking each line as a unit, and separately shines through each into a light receiving component consisting of five light sensitive semiconductors.

(2) Another way is to use strip codes. According to the machinery used, there are two types: One uses paper tape and the other uses punch card. The working principles of the two types are the same, both consist of a typewriter and a strip code reader. The paper tape strip code typewriter can be understood as a kind of ordinary Chinese typewriter, only it uses specially made lead type. On the face of each lead type, there is a strip code which is cast onto the face when the lead type is being cast. The operator presses the key, and the strip code and the Chinese character simultaneously print onto an 8 unit standard paper tape. The strip code is read by the machine. The Chinese character is read by man. The strip code of each Chinese character or symbol consists of 17 digits. It is read from left to right. The first digit is the initiating code and is always "1." The second to the eighth digits are the X codes, representing the page. The ninth digit is the odd-even checking code of the page code.

The tenth to the 16th digits are the Y codes, representing the address on the page, the 17th digit is the odd-even checking code of the address code. Each Chinese character is composed of 14 digits. Therefore the greatest number of codes is $2^{14} - 16386$ Chinese characters. But in actual applications, the ordinary keyboard has 2849 lead types, the rest of the Chinese characters are placed in backup plates and are taken out only when they are to be used. The strip code is converted into telegraphic codes by a reader (device). The signal is then input into computer after it is punched onto a card by the puncher.

In the full keyboard type Chinese character input device, a rational method of arranging the characters must be used to assure rapid and errorless selection of Chinese characters. Generally, two kinds of character arrangements are used: One arranges them in phonetic or standard order (if there are no phonetic characters or when they are not clear, they can be arranged according to standard order). The other is to arrange them by radicals. In actual applications, the frequency of occurrence of the characters and frequently used phrases should be taken into consideration.

2. Ordinary Keyboard Type Chinese Character Input

It uses an ordinary European language typewriter's 46 keys to input the numerous Chinese characters. Although the keys used are few in number, there are many problems in realizing input. Some methods are still being tested and some are still being theoretically discussed. Their future is hard to judge. This method has the following types.

(1) Chinese character input by strokes

This is a method of using a keyboard with keys representing strokes that compose the Chinese character. It inputs Chinese characters by combining several strokes typed a number of times. This method of using strokes to compose the Chinese character according to the order of the strokes is called the Sinotype method, proposed by Caldwell of MIT in the United States. Diagram 2 illustrates this method of using strokes of Chinese characters as elements and their keyboard. Using keys of strokes to input Chinese characters is not as convenient as using sounds of Chinese characters. Figure 3 shows a comparison between the amounts of information of strokes and the phonetic method.

It can be seen from the figure that when using the phonetic method, all of the Chinese characters can be identified by four entries (2166 characters) while using the strokes, the average number of entries is 7. Japan mostly uses the phonetic method to identify Chinese characters (kanji) for Chinese character input. There are at most 7 kinds of phonetic methods to represent Chinese characters. One sound corresponds to several Chinese characters, i.e., there are many homophones. Thus an auxiliary information method is used to reduce the number of characters with the same sound but with different meanings. Japan's Kyoto University has developed a kind of

auxiliary information method which codes the forms of the characters. Figure 4 shows an example of coding of the form of a character.

In addition, Japan also uses a Kana-Kanji transformation method to realize Chinese character input, entering the Kanji into the information processing device by way of a Kana typewriter keyboard and the information processing device transforms them back to Kanji.

Table 1. Chinese Character Input Classifications

Key:

1. Chinese character input installations
2. Keyboard type
3. Full key type
4. Ordinary keys
5. Position indicator type
6. Electronic pen contact input
7. Grid board type input
8. Character from recognition
9. Printed Chinese character recognition
10. Handwritten Chinese character recognition
11. Voice recognition
12. Typewriter type
13. 625 Keys
14. 192 keys
15. Drawing with electronic pen
16. Symbols
17. Letter representation
18. Projected image frequency spectrum method
19. Layer images combination method
20. Right decision and coincidence method
21. Handwritten Chinese character recognition
22. Real time handwritten Chinese character recognition

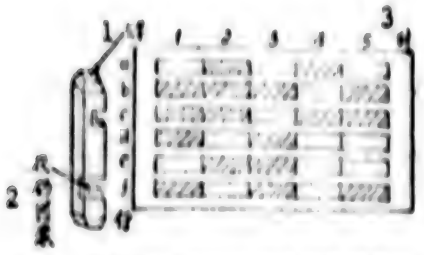

图 1 FACOM 6805A 汉字输入码设计图案

Figure 1. FACOM 6805A movable type and code design

Key:
1. Word
2. Code design
3. Row

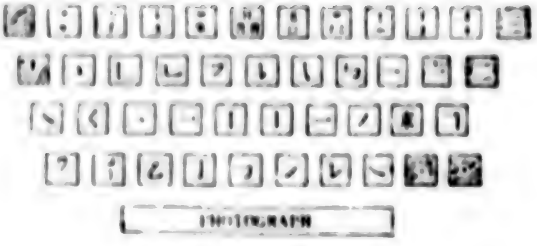

图 2 Sinotype 键盘

Figure 2. Sinotype keyboard

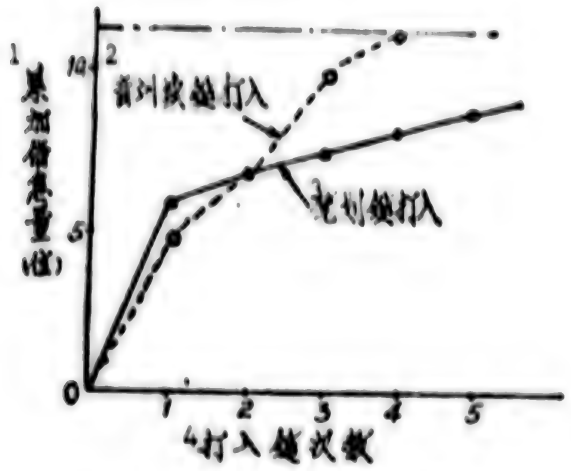

图3 笔划和音训读时信息比较

Figure 3. Comparison of the amount of information for strokes and phonetic entries

Key:

1. Accumulated information amount (digits)
2. Phonetic order keyed entry
3. Keyed entry by strokes
4. Number of entries required

(2) Symbol Codes for Chinese Character Input

This is a method of using numerical codes or several Kana syllabaries as symbol codes to represent Chinese characters. These symbols are combined to compose the Chinese characters. An ordinary letter and numerical input device or a Katakana input device can be used to enter them into an information processor, and according to need, code transformation can be realized in the information processor. The shortcoming of this method is that many entries on the keyboard are required, and an input medium with a large storage capacity is required. What is required is a simple and regular representation which can be easily graspec. There are the following types of methods to realize Chinese character input.

① Numerical Coding Method

Our nation has used this method for telegraphic systems. Numerical combinations are used to transmit Chinese characters. Because this requires looking up the codes in a dictionary, it is not practical. There is another type of "four corner numerical codes" similar to those used in dictionaries. The shape of the four corners of the Chinese characters is divided into ten types designated by the numerical codes 0 to 9 in the order of upper left, upper right, lower left and lower right.

The corresponding numbers are written together and then a one-digit number is added for recognition. Thus a Chinese character is represented by a 5-digit decimal number. Figure 5 shows an example of a numerical code for a Chinese character using the four corner numbering method. Here it is possible to have the same code represent different Chinese characters. In this case, the Chinese characters with the same code must be displayed on the screen (CRT) and then a choice is made.

Using the four corner numbering method allows the addition of other characters without changing the rules. Compared to the methods of using English letters and of numerical search, the four corner numbering method is faster by 1.7 times on the average.

② RAINPUT Method

This is a kind of Chinese character input device developed on the basics of the high speed Chinese character input (high speed typewriter) invented by Japan's Kawakami in an effort to raise the input speed. The high speed device is based on the pronunciation of the Chinese characters. The sound of the Chinese characters is represented by Kana syllabary and entered as input. Since this involves processing homophones, the speed is still relatively slow. The RAINPUT method uses 48 keys in special arrangement. Any two of these keys can be combined to represent one Chinese character, a total of $48^2 = 2304$ characters. If a shifting (shift) operation is executed, the number of Chinese characters can be increased by two times, 4 times and 8 times. Diagram 6 shows the Chinese character keyboard of the RAINPUT method.

The Chinese character keyboard can be arranged either by radicals or phonetically to facilitate the operator to memorize the position of the Chinese characters. The RAINPUT method is no exception and there must be a regular method of memorization. The speed of selecting the characters is much faster than that from a Chinese character keyboard. Its speed can generally reach 120 to 180 characters/minute, 2 to 3 times faster than using a Chinese character keyboard. A skilled operator can input between 20,000 and 25,000 characters in 4 hours in a day's work.

Figure 4. An example of coding of the form of characters

Key:

1. Structure
2. Symbols
3. Samples
4. Partial form
5. Symbols
6. Examples

(a)

(b)

Figure 5. Example of numerical codes of Chinese characters using the four corner codes

Key:

(a) numerical codes for partial diagrammatic forms
(b) Example of the four corner codes

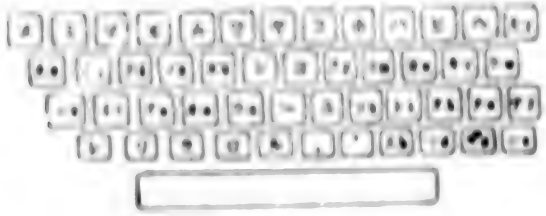

图 6 RAINPUT键盘排列

Figure 6. RAINPUT keyboard arrangement

(3.) SUPERWRITER Method

This method was invented by Professor Yamada Naoyu of the theoretical mathematics department of Tokyo University. The method uses a keyboard of 33 keys. Two Kana syllabaries represent one kanji and two entries are required to input one kanji, a total of 1089 kanji characters, among them there are only 500 Chinese characters. The speed is slightly faster than the RAINPUT method. Figure 7 shows the keyboard, and Figure 8 shows the structure of the system which has already been developed. The shortcoming is that it can input only a few Chinese characters, limited to the Chinese characters used in daily business and information processing.

(3) Input by Letter Representation

This is the keyboard punch card machine SCK-400 developed by the Japanese manufacturer Xinxing Manufacturers. It uses an English typewriter keyboard. The letter keys and the keyboard are separate. Figure 9 shows the arrangement of the keyboard consisting of 48 letter keys and function keys. They are divided into two key zones. Each key zone is formed by 6 x 4 = 24 character keys. The character representations correspond to the keyboard. The structure of the character representations is shown in Figure 10.

It can be seen from the diagram that the character representations are divided into four groups designated RR, RL, LR, LL. Each group is further divided into 6 x 4 character zones. Each zone consists of 6 x 4 characters. On the character keyboard, L corresponds to the left hand operating key zone of the keyboard, R corresponds to the right hand operating key zone of the keyboard. By the character representations of LR, LL, RR, RL and the left and right hand operations of the keyboard, 2304 letters can be produced. These can be entered by the keyboard for Chinese character input. Two entries are required to input one Chinese character. When further expansion is needed, the ESC key can be utilized. Compared to the RAINPUT method, it has the advantages of (1) a faster input speed of over 40 percent, (2) is convenient to use because of a small operating surface, (3) small bulk and light weight, (4) is highly reliable.

There is another type suitable for massive Chinese character input known as the keyed book, shown in Figure 11. Each page has keys that ping up holes, and the pages form a book. The number of pages of the book depends upon actual requirements. Each key represents three or more characters. For example, the 701&AC Chinese character processing system 13 uses the keyed book type input device with 192 keys/page. During input of Chinese characters, there are 192 x 3 characters/page, totaling 14 pages or an input of 8064 Chinese characters.

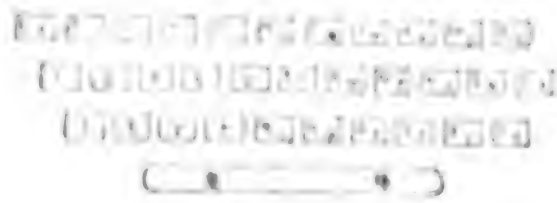

图7 SUPERWRITER键盘

Figure 7. SUPERWRITER keyboard

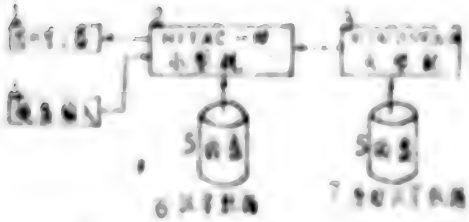

图8 SUPERWRITER系统

Figure 8. SUPERWRITER system

Key:

1. Graphic display
2. HITAC-10 small computer
3. HITAC 8700/8800 large computer
4. Keyboard input
5. Magnetic disk
6. Chinese character data
7. Original Chinese character data

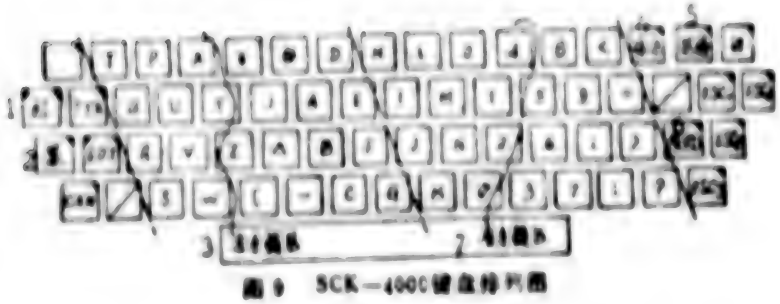

Figure 9. SCK-4000 keyboard arrangement

Key:

1. Red
2. Black
3. Left hand key zone
4. Clear
5. Backspace
6. Correction
7. Right hand key zone

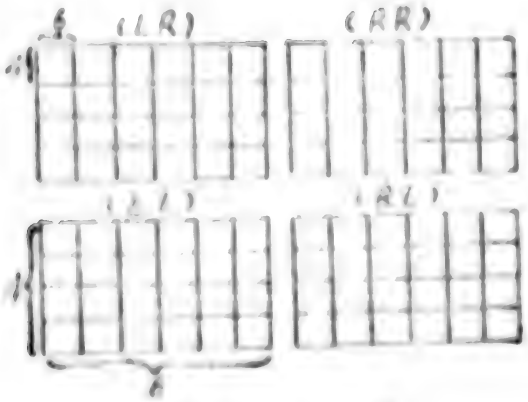

Figure 10. SCK-400 Word List

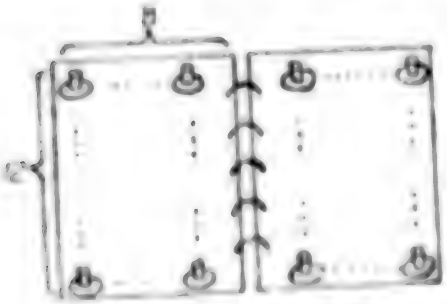

Figure 11. Keyed book type input device

(2) Positional Type Input

This method does not use a keyboard for entry but uses a pen-like indicator to indicate the character on a board to realize Chinese character input. It has two types: one is by contact and the other is by block movement.

(1) Pen Contact Input

This consists of a square board 25 to 150 centimeters in dimension. On the board are grids in which the Chinese characters are represented (it may be a data board) and a pen. When the pen touches the character board, a signal indicating the position of the character is transmitted to the computer for recognition.

The pen is an electronic pen consisting of conductors. There are also photosensitive pens, microphonic pens and magnetic pens.

The pen and the character board at present use the following methods to receive signals: static coupling, sound waves, surface impedance, electromagnetic sensing and surface wave sensing. For example, the FACOM 6378C pen type Chinese character input device uses static capacitor coupling. A table on the character board contains several thousand Chinese characters, kana syllabaries, katakana syllabaries, letters, numbers and symbols. There are 64 along the horizontal direction (X axis) and 48 along the vertical direction (Y axis), a total of 3072 characters, syllabaries and symbols.

When the pen which is connected to the high speed input impedance voltage magnifier touches the character board, an equivalent electrical capacitance is induced between the insulating layers between the pen and the X (or Y) electrode. The working principle is illustrated in Figure 12. When an electrical pulse (voltage) is applied to the X (or Y) electrode, the pulse passes through electrical capacitance coupling and reaches the tip of the pen. The pen's magnifier proceeds with magnification (of the current). Regular and orderly delayed pulses applied simultaneously to the X and Y electrodes will, at this time, cause a phase differential between the signal detected by the pen and the basic standard signal. This phase differential indicates the position of the pen. This phase differential is then coded as a positional code and then transmitted to the computer for processing.

Static capacitance coupling is simple to operate and convenient to use. One input is completed by just one touch. Because it is completely electronic it is highly reliable and its input region can be expanded. The input of words are output in the form of punched paper tape or as a Chinese character display.

In addition, there is another kind that utilizes the photoelectric pen and the emitting diode as Chinese character input devices. The principle of this device is shown in Figure 13.

It can be seen from the diagram that beneath each square containing a character on the Chinese character board is an emitting diode. When the photoelectric pen touches the horizontal emitting diode of the character to be input, all the emitting diodes on the board begin high speed emission and scan in order. When the scan of the diodes reach the diode being touched by the pen, the pen detects the electrical signal and sends it to the address computing device and the signal is converted to a Chinese character code. Then the code is sent to the bugger register. This can be displayed on the monitor and also can be stored in the box type magnetic tape.

There is another type that utilizes the principles of electromagnetic sensitivity for ideographic input. This device uses a magnetic pen and a coding format based on the Gray code. A data board is composed of electromagnetic coils. The magnetic pen detects a position and generates a current and polarity of a certain inductive electric potential. Its characteristics are: (1) The output is basically a numerical code. (2) Its read-out is fast and it is not affected by noise. (3) The input can be in handwritten form and a hard copy can be obtained. This type of device can be used for real time handwritten input systems for Chinese characters.

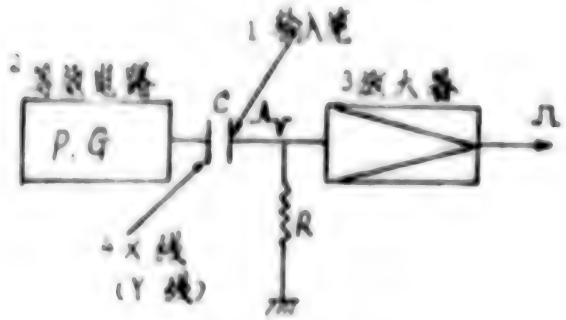

图2 [illegible]

Figure 2. Working principle of word board of pen contact type

1. Input pen
2. Encoding circuit
3. Magnifier
4. X line (Y line)

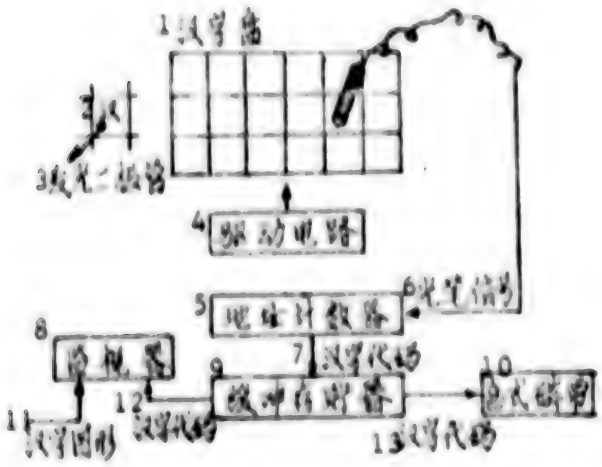

图13 发光 [illegible]

Figure 13. Illustrated principle of the emitting diode device

Key:

1. Chinese character board
2. Han
3. Emitting diode
4. Drive circuit
5. Address tally device
6. Photoelectric pen signal
7. Chinese character code
8. Monitor
9. Buffer storage
10. Box type magnetic tape
11. Chinese character diagram
12. Chinese character code
13. Chinese character code

(3) Block Movement Type Input

This method is to separate the character board and the ideographic board that detects positional signals of the characters. The positions on the character board and the positions on the ideographic board correspond to each other. They are connected by a mechanical magnification and miniturization device. Figure 14 shows a holographic Chinese character input device. It consists of a character board composed of three character groups and a holographic code board. Each character group is arranged as a matrix of 32 x 32 characters. Each character square is 4 millimeters. The holographic code board is a 1 x 1 millimeter microhologram of 32 x 32 characters arranged in a matrix. They correspond to the position of each character on the character board. Each square is represented by a binary code of 10 digits.

The photosensitive pen passes through the magnification and miniaturization device and connects with the indicator on top of the holographic code board's microhologram. When the laser inside the light-sensitive pen shines upon the hologram, light refraction is produced by the different information codes recorded on the hologram. The refracted light focuses

on 10 photosensitive semiconductors and thus a 10-digit character code is given. The codes of the character board and the positional codes of the characters are combined in the control circuits and output as a 12-digit character code. Its advantages are: inexpensive in price, convenient to change the character codes, only a change in the holographic code board is required, the arrangement of the characters can be chosen at will, and the character board can be miniaturized.

To achieve processing of special words such as place names and personal names, a Chinese character dictionary input device is installed. When an "outside character" is to be input, a search through a dictionary is a common method used. A scanner with handle scans the strip coded book of Chinese characters. The operation is simple. the OKI KANJI CODE ENTRY-200 can have a maximum capacity of 16384 characters.

III. Chinese Character Recognition

As Table 2 shows, there are many input forms for Chinese character recognition. In general, the specific definition of Chinese character recognition refers to the three forms listed first in the table. But when need is considered, the most ideal input form is machine-linked handwritten Chinese character recognition, but this is very difficult to implement. At present, recognition techniques are limited to single printed Chinese characters.

Recognition of printed Chinese characters is much more difficult than numerical recognition. First, there are many characters to be recognized, about 2000. Therefore the character forms are very complex and the amount of information is very large. For example, if a Chinese character is represented by a 48 x 48 grid, then to represent 2000 characters, 5×10^6 digits of information are needed, about 500 times the amount of information needed to recognize Chinese characters numerically. Second, in Chinese character recognition, the problem of "outside characters" exist. "Outside characters" refer to those characters not included in the device itself. Processing of "outside characters" can only be solved by considering the structure of the entire system. This is a very troublesome problem. At present, achievements have only been made in the recognition of 2000 single printed Chinese characters. In the following, several methods of Chinese character recognition currently being used are introduced.

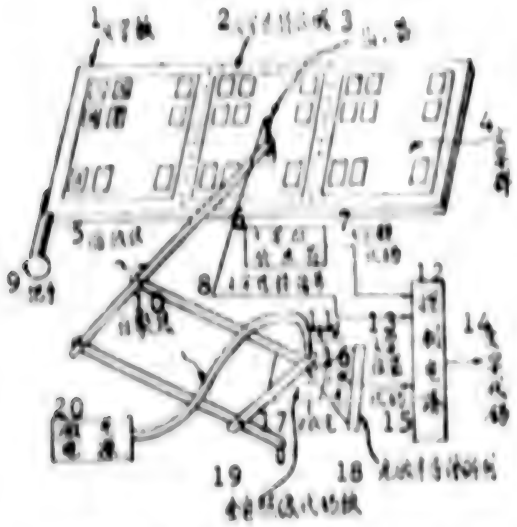

图14 采用全息照相技术汉字输入装置

Figure 14. Chinese character input device using holographic techniques

Key:

1. Character board
2. Character selection area
3. Indicator
4. Character group
5. Magnification and miniaturization device
6. Character group pickup device
7. Character group code
8. Selected character translation signal
9. Handle
10. Autofocus
11. Photopen
12. Control circuit
13. Character position
14. Character code
15. Code
16. Secondary light
17. Secondary light
18. P tosensitiv semiconductor array
19. Holographic code board
20. Laser source

表2 汉字识别之分类

		7 必要性	11 识别难度
1	手写汉字	8 大	8 大
2	实时手写汉字	9 小	10 中
3	印刷汉字	10 中	10 中
4	实时印刷汉字	10 中	9 小
5	カナ汉字·英	10 中	8 大

Table 2. Classification of recognition of the forms of Chinese characters

Key:

1. Original information form
   Handwritten Chinese characters
2. Real time handwritten Chinese characters
4. Printed Chinese characters
5. Real time printed Chinese characters
6. Kana kanji conversion
7. Necessity
8. Large
9. Small
10. Medium
11. Degree of difficulty

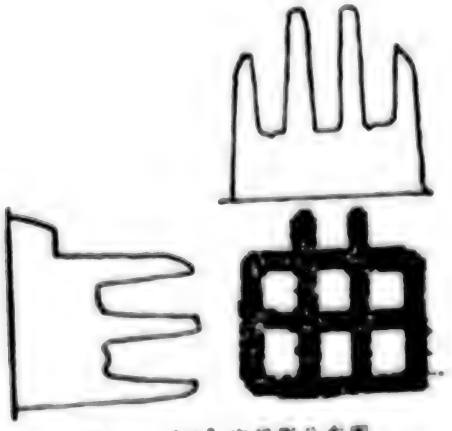

图15 "曲"字投影分布图

Figure 15. Projected image of the characted "qu"

1. The Method of Chinese Character Recognition by a Projected Image Frequency Spectrum

A projected image means the integration of an image of a character in the X and Y directions. Figure 15 shows a two dimensional grid diagram and a projected image of the Chinese character "qu."

Projected distribution is characterized by the fact that a two dimensional character form's one dimensional projection can preserve the form of the original character. Therefore it can be used for the recognition of single printed Chinese characters.

Let the form of the character be defined as:

$$P(i,j) = \begin{matrix} 0 \text{ (blank)} \\ 1 \text{ (character)} \end{matrix} \quad \ldots\ldots\ldots\ldots 1$$

where $i, j = 1,2,\ldots\ldots\ldots\ldots\ldots\ldots, N$

Then the horizontal distribution of the projection can be defined as

$$X(i) = \sum_{j=1}^{N} P(i,j) \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

the perpendicular distribution of the projection can be expressed by the form in (2).

This method can recognize up to 99.4 percent of printed Chinese characters of bold type in a 30 x 30 grid. But the projection produces a positional shift and the compressible amount of information is small. To improve this, an oscillating amplitude frequency spectrum is used to generate the projected image. This method involves computing the absolute values of the Fourier transform of the projected image. It is characterized by the fact that the projected image is not distorted by changes in the position of the character, and because the image undergoes frequency spectral analysis, the composition of the frequency can be effectively selected to eliminate the effects of noise.

The compressible amount of information can reach about 1/10 of the original form and the percentage of recognition can reach above 99.9 percent. This is higher than the method of recognition of projected images. The major shortcoming is that it is not sensitive to the variations in line width. For this, a kind of supplementary frequency spectrum is used. Besides horizontal and vertical directions, four other directions of projection are added at $\pm$ 45°.

The structure of the system of the method of projected images using a frequency spectrum is illustrated in Figure 16. Because the amount of storage of standard forms is reduced, a small computer with a magnetic drum can be used to perform machine linked real time experiments. The computer is connected to a device for character information detection by laser scan. This system can read size 4 type face printed Chinese characters. The recognition speed can reach one character per second.

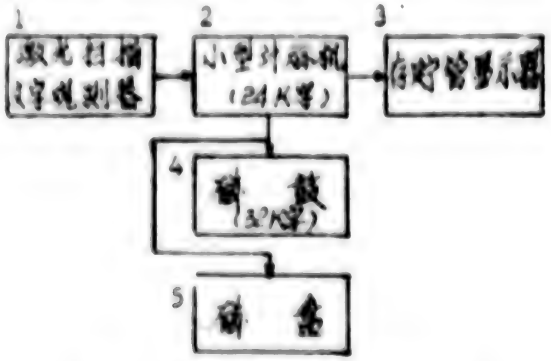

图16 投影分布图频谱法系统结构图

Figure 16. The diagram of the structure of the system of the projected image frequency spectrum method

Key:

1. Laser scan character detector
2. Small computer (24K words)
3. Storage tube display
4. Magnetic drum (32K words)
5. Magnetic disk

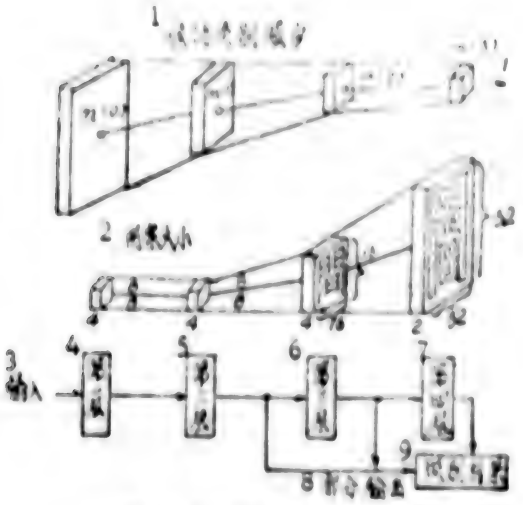

图17 阶层图象合成法框图

Figure 17. Block diagram of the layer image combination method

Key:

1. Alternate types reduce
2. Design's size
3. Input
4. First layer
5. Second layer
6. Third layer
7. Fourth layer
8. Partial output
9. Result of recognition

2. The Method of Layer Combination

To raise the speed of Chinese character recognition, the amount of information of the Chinese character image must be compressed. But the result will reduce precision of recognition. To solve the conflict between speed and precision, a method of layer image combination is used, as illustrated in Figure 17. It classifies the characters and recognizes them in four stages. The number of characters reduces as the number of layers increases but the amount of information increases as the number of layers increases. This means, precision of recognition is raised as the number of layers increases while the number of characters to be recognized reduces. Generally speaking, the amount of information to be processed by the computer is greatly reduced.

The advantage of this method of combining images of different layers are: (1) It can elevate the efficiency of recognition of Chinese characters. (2) The ability to resist interference by noise is increased and a higher reliability is obtained. (3) Because the computation of the image does not rely upon the particular characteristics of the characters, a standardized general purpose recognition device can be designed which is unrelated

by the type face of the character. The method of representation of Chinese characters by layers has already been used in the recognition of handwritten Chinese characters.

But the shortcomings are: (1) Each layer must have a standardized recognition pattern. (2) Because it has only a two dimensional processing capability, it cannot be used for one dimensional processing. This means poor versatility. For this, the method of layer image combination of frequency zones (HPMZ) is used. It requires a two dimensional Fourier transform and a complex number and vector correlator. The percentage of misjudgment recognition in an experiment of 1850 Chinese characters of a single printed type face was 0 percent and the percentage of rejection was 0.05 percent. These indicate that a level for practical application has been reached. But, because the unknown input at the beginning requires a two dimensional Fourier transform, this has presented difficulties for hardware. In addition, the quality of the printed character for input must be strictly regular. Figure 18 shows the structural system of recognition of handwritten regular script of Chinese characters. It consists of a detection device, a small computer, a joint processor and a controller as a system with four sub-systems.

The detection device consists of a processing component and an "eye" for abstraction of characteristics. After the processing component completes the "refinement" of the character and abstracts the detection points, the "eye" component abstracts the form. The small computer has a word length of 16 digits. It has an internal storage capacity of 8K. It completes the following in the recognition process: (1) Composition of a preliminary design and a sub-design. (2) It computes the maximum given suitability and decides the content of the character. (3) It decides the positions of the detected and the undetected parts of the form of the character.

The two parts of the joint processor (A,P) separately correspond to a subgroup of the form of a character and are composed of the A P 1, A P 2, and A P 3 portions of the form of the Chinese character. It uses a two dimensional distribution logic system (D,L,S) as the basic compositional unit. The numbers of single unit groups of each form compose complete form. Its task is: (1) To compute the degree of similarity and suitability and (2) decide the most suitable form and the second most suitable form.

The controller is controlled by the program of the small computer and consists of the command register for the control program of the joint processor, the set of commands of the executive register and the logic component of the detection control device. It completes (1) determination of the position and the size of the "eye" and (2) executes commands related to the small computer and the joint processor.

2. Recognition by "Correct" Decision and Comparison

This method started out as a method of recognition of words and numbers. At present it has been applied in the recognition of Chinese characters.

The method involves recognition of a given input in unknown diagrammatic form and computer decision to decide which of two categories a Chinese character would belong to. The rules are as follows:

If A,B represent two categories, then all "correct" forms (A,B) can be decided by the function written as

$$\psi_{AB}(X) = A,B \text{ or } \phi$$

It decides the unknown diagrammatic form X as belonging to A or B or is unrecognizable (ϕ).

If for all categories B $\neq$ A and B is established as

$$\psi_{AB}(X) = A$$

then the decision is X = A

Making the "correct" decision is not affected by other categories, and this point is especially important. For example, in deciding on (A,B) in a series of paired categories (A,B), (A,C), (A,D),.....(A,E), the decision is not affected by the categories C - Z. For this, a "competitive elimination method" shown in Figure 19 is used. For example, to recognize the characters "wen" and "jian," the common radical "men" must first be eliminated. On this basis, consideration is given to the coincidence of the remaining parts and their correlation is computed and thus a precise determination is obtained. This kind of processing procedure is relatively simple. All that is needed is to add some processing steps on the basis of the correlation method.

Japan uses this "correct" decision method to recognize 500 taught Chinese characters of more than 9 strokes. Sixteen type faces were chosen for each character, totalling 8,000 character types for the experiment. The results yielded a rejection rate of 0.1 percent and a mistaken recognition rate of 0 percent.

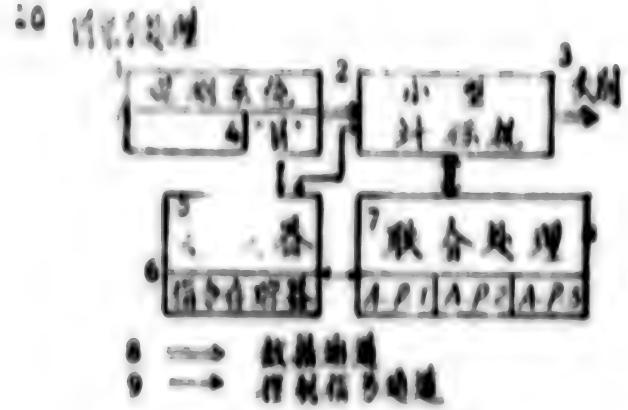

图18 识别系统结构框图

Figure 18. Block diagram of the structure of the recognition system

Key:
1. Detection system
2. Small computer
3. Category
4. "eye"
5. Controller
6. Command storage
7. Joint processing
8. Data channel
9. Control signal channel
10. Preprocessing of image

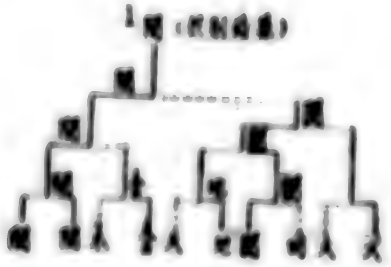

图19 对竞争淘汰法的判定例

Figure 19. An example of the competitive elimination method of determination

Key:
1. (Result of recognition)

4. Handwritten Chinese Character Recognition

(1) Machine linked handwritten Chinese character recognition

This is a method of using real time recognition processing to complete Chinese character input via a dot coordinates input device that inputs Chinese characters written on it with an electronic pen. Recognition of handwritten Chinese characters utilizes line segments of strokes as the unit for structural analysis. It is based on the signals generated when the tip of the pen points upwards or downwards during the handwriting process. These signals are separated and the strokes that compose the Chinese character are abstracted. Then the machine decides whether the stroke is a basic stroke, and recognizes the character by determining the unit number of strokes and the characteristics strokes (compound strokes). If there are several versions of a character, the final character is determined by detecting the position of the basic strokes, the order, the relative positions and the characteristic "decisive branched network" of each character based on ordering and combination.

There are many types of basic strokes being used. Table 3 shows one example of the basic strokes used in the recognition of handwritten Chinese characters. Its major shortcoming is the pen must be attached to the terminal equipment of the diagrammatic board and therefore it is not suitable for massive information input, but, because it can directly reflect the results of recognition, it is suitable for correcting the recognized characters, and it is a powerful means of man-machine communication. This method has already been used in the editing and correction of original drafts.

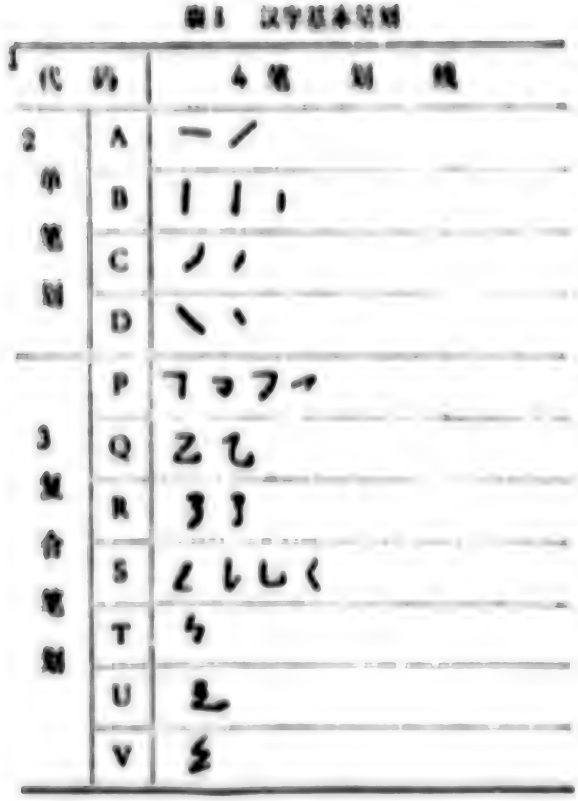

Table 3. Basic strokes of Chinese characters

Key:
1. Codes
2. Simple strokes
3. Compound strokes
4. Stroke lines

The key to machine linked real time recognition of handwritten Chinese characters is that it has developed a kind of simple ideographic character input device with a high resolution, i.e., a design board and a computer dictionary. The data based diagrammatic input device developed recently upon the principle of electromagnetic induction has already been used in the handwritten Chinese character input device. This method enables one to recognize the 952 characters including all of the 881 taught Chinese characters (in the Japanese language) and katakana syllabaries. The percentage of recognition reached over 90 percent.

(2) Recognition of Chinese characters of handwritten type face

Recognition of Chinese characters of handwritten type face uses the BS method and the layer representation method. These two methods all use regular script characters. Massive amount of data processing is needed,

therefore the time for recognition processing is very long. In addition, it is difficult to unify the various handwritten type faces of different people. At present, recognition of handwritten Chinese characters has become a problem that urgently requires solution.

5. Voice Recognition

The development of voice input devices has been rather rapid. At present, the simulated vocal band structure is used. It only recognizes the voice of certain designated individuals and predetermined simple phrases. In the United States, this has been applied to toys. In our nation at present, the machines can recognize 400 short phrases and the percentage of recognition reaches 99.7 percent, approaching practicality. But to recognize the speech of ordinary people and to use voice recognition as an input for Chinese character information processing systems will require great efforts.

IV. Conclusion

Foreign nations have been conducting research in Chinese character input devices for many years. At present, various kinds of devices have been developed. Our nation is presently conducting research in Chinese character information processing systems. A Chinese character composition processing system has already been developed. Besides the various kinds of problems encountered in the structure of the Chinese character input device itself, there are also the following problems in actual applica-io tions:

(1) "Outside character" processing. Processing of "outside" characters via keyboard or character board often requires the use of numerical code tables of these outside characters. In addition, various types of composite diagrammatic methods are used.

(2) Errors and their correction in Chinese character input are rather complex. In the keyboard input device, generally the errors are pinpointed by viewing the display or the monitor of the typewriter and then handled. The difficulty in Chinese character recognition and revision processing is great and needs to be further perfected.

(3) Standardization of Chinese characters must be solved. At present, various types and variety make it difficult for Chinese character input. General purpose devices which are suitable for input of Chinese characters of any specification must be produced and this is not an easy task and at least it is impossible at present.

(4) Standardization of coding of Chinese characters must be solved. For the needs of the users, it is necessary to standardize Chinese character codes.

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9296
CSO: 8011/1344

FOOD COMPANY USES SOLAR ENERGY TO SAVE COAL

Beijing GUANGMING RIBAO in Chinese 19 Jun 80 p 1

[Photo Caption]

This is a tracking type solar energy water heater developed by the Food Service Company of Linxiang County, Hunan. The apparatus can automatically track the rising and setting of the sun, constantly keeping the heat collection surface aimed at the sun for maximum absorption of the sun's energy. The heat collection surface is composed of two units with a total area of 6.75 square meters. On a clear day with 10 hours of sunshine at an average of approximately 20°C, it can produce 900 kg of hot water from 40°-60°, thus saving 25 kg of coal daily.

CSO: 4008

PLIGHT OF GUANGDONG CANCER VICTIMS REVEALED

Guangzhou NANFANG RIBAO in Chinese 12 May 80 p 1

[Article by He Yunteng [0149 6663 7506], reporter of this paper and correspondents Sun Konghua [1327 1313 5478] and Feng Liuxiang [7458 9497 4382]: "Solution Demanded for Difficulties in Treatment for Guandong Cancer Victims"]

[Text] Cancer is a common disease that severely endangers people's health and lives. In recent years, the frequency of occurrence of cancer keeps increasing in our province. According to statistics provided by the agencies concerned, the number of cancer cases in our province is about 1.28 per 1,000 total population; each year there are between 60,000 and 70,000 cancer victims. In recent years in our province, deaths due to cancer have exceeded the total number of deaths from 17 contagious diseases combined; it is the number one cause of all deaths resulting from disease.

For a long time, however, the treatment and hospitalization of cancer patients have become a big problem.

The only tumor hospital in our province was founded in 1964, owing to the concern of Comrade Tao Zhu and the Guangdong Provincial Committee. In the early years of the founding of the hospital, the technology and equipment of the Tumor Hospital ranked third in the nation. The reputation of the hospital was very good, and tumor victims from a dozen provinces and municipalities came here for treatment. In the early 1970's, when the Tumor Hospital became an affiliated teaching hospital for Zhong Shan Medical School, conditions of the hospital became limited, and the hospital gradually fell behind those in many sister provinces with respect to size, equipment, and technology.

Today, many provinces and municipalities with a smaller population than our province have established tumor hospitals with more than 500 beds, and in nearly 10 provinces and municipalities the hospitals are equipped with advanced radiotherapy equipment of the 1970's--linear electron accelerators. One prefecture in Henan Province boasts of eight Cobalt-60 machines. Yet the two Cobalt-60 machines at the Tumor Hospital in Guangzhou

were purchased in 1957 and 1970. These two machines often break down; sometimes, poisonous mercury leakage occurs, thereby affecting the health of hospital personnel. Several years ago, with the approval of leading comrades on the Provincial Committee, the Tumor Hospital bought an electronic induction accelerator made in our country. But construction work for the housing of the accelerator ceased after 4 years, before it was completed. To date the accelerator is still lying there for a long sleep, and certain machine parts and electronic materials have deteriorated.

Guangdong is an area with a high frequency rate of nose and throat cancer. Research on nose and throat cancer is an emphasized scientific research item which the state has assigned to our province. The medical staff of the Tumor Hospital have accomplished much in this regard, having twice presented their results to international cancer prevention conferences. Judging by the level of therapeutic techniques at the hospital, if nose and throat cancer patients in early stages are given early treatment, their rate of survival for more than 5 years can reach more than 80 percent. At the present time, the major treatment for nose and throat cancer is radiotherapy. Owing to the outdated equipment at the Tumor Hospital and the frequent breakdown of the machines, however, the hospital is unable to meet the needs of numerous patients, despite the efforts of the staff of the radiology department, who work continuously for more than 10 hours daily in three shifts. The patients often have to wait for months for their turn for radiotherapy, with the result that they miss the optimal time for treatment, and their condition proceeds from the first stage to the second and third stages.

Patients who request in-hospital care face even greater difficulties. There are only 120 regular beds in the Tumor Hospital. In order to take in more patients, the hospital goes to extremes to add makeshift beds, but that merely increases the number of beds to 360. Since the added beds are not in regular allotment, the personnel and material supply for these beds do not receive the needed replenishment. At present, general detection of tumor cases has been extended to the entire province. Cancer victims found through general detection all come to Guangzhou for treatment, but they often are unable to find hospital beds. Because of the age of the equipment and the scarcity of beds, the rate of admission of nose and throat cancer patients to the Tumor Hospital has decreased to 40 percent, compared with 66 percent in the past. Unable to get admitted to the hospital, some patients roam the streets, some sleep on the floors in the hospital's hallways, and some even live in shacks built near the entrance to the hospital. Pressed for a solution, the medical staff has resorted to moving some patients to Hunan and Guangxi provinces for treatment. Since last November the hospital has referred nearly 100 cancer patients to out-of-province facilities for treatment.

Do the leading authorities fail to understand the situation? Are the health departments unwilling to resolve such urgent problems of tumor care? Not at all! It is hard to believe that the key issue turns out to be the administrative organization. Currently, tumor hospitals in every

province and every municipality in the country (Guangdong and Shanghai excepted) are all under the direct control of local health departments. Because Zhong Shan Medical School is under the direct leadership of the Central Health Department, the Tumor Hospital, being a teaching hospital, is limited in terms of personnel, beds, equipment and budget. It is said that concerned provincial authorities once tried to untangle the Tumor Hospital's problems regarding beds, equipment and funds, but could do nothing because of the unresolved organizational situation. Furthermore, the Tumor Hospital's superiors consider that, as a teaching hospital, 120 beds are sufficient and cannot be increased. With regard to the problems of the Tumor Hospital, the provincial health authorities have proposed a solution: Based on the existing facilities at the Tumor Hospital, the provincial government will provide funds to increase the number of beds, supplement and renovate the equipment, enlarge the staff, install dual leadership, convert the Tumor Hospital into a provincial center for tumor prevention, scientific research, and personnel training, and allow Zhong Shan Medical School to retain the Tumor Hospital as a base for teaching and research. But some of Zhong Shan Medical School's top officials deem that the shortcomings of dual leadership outweigh the advantages. They want to maintain the status quo and only wish to receive committed support in terms of personnel and funds from the provincial government.

Thus, some leaders talk a lot, walk a lot, and argue on paper a lot without solving the organizational problem. We appeal to the leading comrades of concerned agencies; get out of your offices, listen closely to the cries of cancer victims, speed up the solving of problems related to the suffering of the masses, and do a very good deed for the masses!

9640
CSO: 4008

LIFE SCIENCES

'HUNDRED FLOWERS' OF RESEARCH METHODS URGED

Luda XINLI XUEBAO [ACTA PSYCHOLOGICA SINICA: JOURNAL OF PSYCHOLOGY in Chinese No 1, Feb 80

[Article by Wang Jisheng [3769 2817 4141] of the Psychology Institute of the Chinese Academy of Sciences: "Fundamental Theory and Methodology of Our Nation's Psychology"--From the practice of our nation's psychology over the past 30 years]

[Text] Our nation's psychology has already gone through a difficult course of development of 30 years since the founding of the nation. Now, we are reviewing the experiences and lessons learned during these 30 years of development of our nation's psychology based on the view that practice is the only standard to examine truth. This has become an important subject of study in the modernization of our nation's psychology.

I

Wilhelm Wundt established his psychology laboratory at Leipzig in 1979 and thus ushered in the era of modern psychology. It has been exactly 100 years now. The history of 100 years of practice of modern psychology has shown that different schools of psychology have been produced by different viewpoints concerning the basic theory of psychology. For example, functional psychology advocates that psychological activity is the means in which organic animals adapt to their environment. The effectiveness of adaptation is the nature of psychological phenomena. Behavioral psychology further advocates that psychology study only behavior. Recently, Soviet psychology has regarded the unity of consciousness and activity as one of the basic principles of understanding the true nature of psychology. The activity theory proposed by (Leongdev) already has become the unique subject of the (Leongdev) school of thought.

Most of the comrades of our nation's psychology circles have followed the dialectic materialism of Marxism as a guide, and have regarded the theory that psychological states are fu ·tions of the brain and the reflection of objective realization as the fur ental theoretical view in understanding the true nature of psychology an leveloping psychology to serve socialist

work. The author believes this is the theoretical foundation which must be upheld in developing our own path of development of our nation's psychology. We must expose the patterns of psychological activity. We must study the material nature and mechanism of psychological activity and also the dependence and effects of psychological activities upon social practice. The two are dialectically unified, not mechanically added to each other.

But in implementing this fundamental theoretical view of psychology, two digressions have occurred: an inclination of psychology to become biological in nature, and an inclination of psychology to become sociological in nature.

The inclination of psychology to become biological in nature is the result of unilateral emphasis on the study of so-called physiological mechanisms of psychology and a neglect or negation of the dependence and the important effect of psychology upon social practice. For example, such emphasis has resulted in an attempt to use some concepts of physiology of higher nervous activities to directly explain complex psychological phenomena, an attempt to use so-called establishment of a fixed pattern of movements to explain all emotions in human life, including moral feelings and class feelings.

The true nature of the inclination of psychology to become biological in nature is the reduction theory of psychology. In the various forms of movement of material objects, higher forms of movement include lower forms of movement. But higher forms of movement cannot be reduced to lower forms of movement. Otherwise this would be a negation of the basic fact of world development. Psychological activity, as a higher form of material movement includes such lower forms of movement as physiological activity. But the former cannot be reduced to the latter. The reduction theory of modern psychology, whether it is a hidden theory of reduction or a publicized theory of reduction, attempts to understand man's psychological states as physiochemical or physiological processes. It belives psychological studies of man can be conducted and replaced by objective physiology. It attempts to explain the occurrence and the nature of man's psychological states from the point of view of physiology and even physics and chemistry, while negating the special characteristics of the psychological nature of man. They do not understand that human psychology is not only inseparable from the higher nervous system in physiological development but also is inseparable from all aspects of social development. And the two are mixed together.

An important factor that caused the inclination of our nation's psychology to become biological in nature was the dogmatism of following behaviorist psychology and Pavlov's theories. Pavlov's theories about higher nervous activities have a definite and active historical significance in the materialist discussion of the material nature of psychological activities. In 1950, after the joint conference on Pavlovian physiology was held jointly by the Soviet Academy of Sciences and the Soviet Academy of Medical Sciences, some scholars attempted to include without distinction all objects of psychology in the physiology of higher nervous activities as the only form of

study of human psychology. This view of making psychology become biological in nature in fact would mean the elimination of psychology. This exerted a very devastating effect during the early period of development of psychology in new China. At the time, China's psychological circles proposed establishing psychology on the foundations of Marxism and Pavlovian theory, and advocated Pavlovian theory as the important natural science foundation of dialectic materialist psychology and the use of Pavlovian theory to reform psychology under the guidance of Marxism-Leninism. These advocacies are undoubtedly correct in emphasizing Marxism to guide psychology. But unilateral exaggeration of the importance of Pavlovian theory in psychology and elevating it to the same level as Marxism were the roots of the inclination of psychology to become biological in nature--a phenomenon that occurred during the beginning period of development of new China's psychology.

On the road of development toward modernization of our nation's psychology, psychology has absorbed its nutrients from modern natural sciences. Some have relentlessly drawn upon new theories, new concepts, new methods, and new techneques of natural science. All of these have imporrant and active significance in scientifically exposing the nature of psychology. We should take modern scientific techniques such as biophysics, biochemistry, neurophysiology, information theory, systems theory, techniques of electrophysiology, automation and remote control techniques, and the theory and methods of genetic engineering to creatively study the material nature of psychological activities. But we must not digress into an attempt to directly explain all the patterns of psychological activities by variations of the electrical potential of the brain or chemical changes.

The harmful effects that the ideological trend of psychology to become sociological in nature has upon the development of our nation's psychology is also worth guarding against.

An important characteristic of the so-called maovement to criticize psychology in 1958 and the so-called movement to struggle against, criticize, and reform psychology during the Cultural Revolution (for psychology, this actually meant to struggle against, criticize, and shatter) was the emergence of a kind of rough metaphysical ideolocal trend to make psychology sociological in nature. Such an ideological trend started out by unilaterally emphasizing that psychology is the reflection of objective reality, by unilaterally emphasizing the dependence of psychology upon social practice, and adding an unlimited number of such extreme emphases. All human psychological activities were regarded as the products of class struggle, and they all possessed an overall class nature. [This ideological trend] even refused to recognize that people of different classes all know that manure stinks. It even believed psychology should become a simple and pure class psychology. Thus, political ideology was equated with psychological activities, and political ideological work replaced psychological study. Class analysis replaced psychological studies, and finally psychology would be destroyed and smashed.

Under the influence of the extreme leftist line of Lin Biao and the "gang of four," the guidance of psychology by Marxism-Leninism and Mao Zedong Thought was dogmatically emphasized. Understanding of Marxism-Leninism and the body of Mao Zedong Thought was not complete and accurate, but portions of the statements of these revolutionary teachers were singled out to derrive conclusions in psychology and to substitute them for scientific research in the true nature of human psychology. Philosophy was used to replace psychology. The ways of mass movement were used to solve academic discussions in psychology. This brought devastating effects upon psychology.

This kind of ideological trend of making psychology sociological--which raises the leftist banner, which would rather pursue leftist tendencies than rightist tendencies, and which feels the more leftist leaning the better--is more deceitful. It had brought even greater damage to the development of our nation's psychology than the t end of psychology's becoming biological. The lesson is painful.

The experience of history shows that without concrete research in psychology, a general unrealistic and empty discussion of guiding psychology by Marxist philosophy may lead to useless talk, simplification, vulgarization, pragmatism, and substitution of ideological and discrimatory philosophizing for psychological research. This will not only prevent psychology from developing forward along a healthy path but will, conversely, force scientific psychology backward into the arms of ideological and discriminatory philosophy. It also gives Marxist philosophy a bad name.

Of course, we must also clearly notice that when studying a certain specific subject of psychology, we must not forget to utilize the guidance of dialectic materialism. This means not simply picking up any topic for study but conducting research in modernizing and making parapsychology scientific and studying the true nature of human psychology. Otherwise, a situation will be created in which psychology becomes stagnant for a long period.

The inclinations of psychology to become biological and sociological are, respectively, extreme tendencies which regard psychological states as the functions of the brain and reflections of objective realities while neglecting to conduct concrete analysis and examination of the true nature of human psychology. But practice proves that criticizing psychology for becoming biological, not holding firmly to the complete view that psychological states are functions of the brain and reflections of objective realities but taking statements out of context, and unilaterally emphasizing the socialization and the class nature of human psychology and thus being overly critical will all force psychology off course to become sociological. In criticizing psychology for becoming sociological, unilateral emphasis on the importance of research in the material nature of psychology, unilateral emphasis on the so-called scientific and objective natures, and unilateral emphasis on the number of research methods may possibly force psychology to become biological.

Along the road to realizing the modernization of our nation's psychology, the 30 years of experience and lessons must be summarized and the fundamental theoretical view that psychological states are functions of the brain and reflections of objective reality must be dialectically upheld. The inclination of psychology to become biological and sociological must be prevented and overcome. In studying the material mechanism of psychology, one must prevent neglect of the social limitations of psychology. In studying the social limitations of psychology, one must prevent the research that negates the material mechanism of psychology, and avoid falling into the hopeless situation of mindless and unrealistic psychology. One must understand dialectically that psychological states are the functions of the human brain and reflections of objective reality, and that the two are organically unified. The two are unified in life's practice and are united in man's recognition of the objective world and changing activities. Of course, when we study a certain subject, we are allowed to set aside a certain aspect temporarily, but at the end the two aspects must be organically unified. When we are giving a theoretical explanation of the scientific facts obtained in the concrete study of a subject, bias toward either of the two aspects will prevent a correct understanding of the significance of the psychological facts obtained. In the future, even when the inclinations for psychology to become sociological and biological occur, reason must be used to convince personal opinions but authority must not be used to suppress people, and those holding differing academic views should be allowed the right to speak out.

We must use the position, viewpoint and methods of Marxism to guide the study of psychology, but we must not use only certain statements of Marxism to replace the study of psychology. Practice is developing and recognition is deepening. Different academic opinions concerning certain expositions on psychology expounded by classical writers of Marxism can normally be taken up in academic discussion. If the expositions of classical writers of Marxism concerning psychology are taken as the ultimate truth, then people's in-depth recognition of the true nature of psychology will necessarily be limited. Practice has proven that the extreme leftist line of Lin Biao and the "gang of four" has set up many prohibited areas of psychology. For example, questions of intelligence, testing of intelligence, motive, need, will, personality, hypnosis, unconsciousness, animal psychology, social psychology, psychological consultation, psychological health, and psychiatry have for many years been areas prohibited from our nation's psychological research. Practice shows that research into these problems and judging right from wrong are actually needed. In the past, regarding these topics as prohibited was wrong. At present, some of these prohibited areas have been opened up; some are being touched upon; some have not been mentioned. Generally speaking, ideology still needs to be liberated to thoroughly open up these prohibited areas. But opening up these prohibited areas does not mean lightly repeating other people's work; hard work is required to create new fields of exploration. To open up the prohibited areas of psychology can allow us to explore in depth the true nature of psychology from different sides.

Practice proves that in our theoretical and experimental research in psychology, creative theoretical research and creative experimental research are still insufficient. We do not have our own independent view of the fundamental viewpoint of psychology, and it is therefore very difficult to have true academic thought in the field of psychology. Regularly following the established rules, routinely keeping to the old, following the development of psychology abroad, and trying to surpass it can only be an equidistant chase, and at most we can only maintain a middle position; we may even possibly be going in the wrong direction. We must break free of the bonds of the traditional theoretical viewpoints of psychology, deepen criticism of this approach, and exert efforts to create. We must select the strategic goals of surpassing foreign nations in psychology by considering such aspects as fundamental theory, basic theory and creating new regions of exploration based on the characteristics and trends of present psychology and the actual characteristics and demands of development of psychology that serve our nation's socialist work, and we must follow our own path of development of our nation's psychology. We must try to establish our nation's brand new body of psychology with the following characteristics by the end of the 20th century. 1. A basic theory of psychology (including methodology) under the overall guidance of dialectic materialism should possess a unique character. 2. Psychology possessing our nation's national character should fully exploit and elevate the rich psychological thoughts of our nation's history, and fully reflect the spirit of the historical practices of the masses of people in our nation's socialist era of marching toward the four modernizations. 3. Psychology should encompass the character of both natural and social aspects and should not unilaterally emphasize any one aspect. 4. Psychology should possess the characteristics of the era and fully utilize modern scientific theory and advanced techniques to study psychological problems. 5. Theory should be closely combined with practice. A practical outlook and an outlook on life also should be the basic and foremost views of psychological research. The theory of psychology comes from practice, is examined by practice, and develops through practice to serve the task of realization of the four modernizations and further future development.

To realize the above goals, an important task in the battlefront of the theory of psychology of our nation at present is to closely combine theory with the practical situation of our nation's psychology of the past 30 years and open up discussions on the question concerning the standards of truth. We must insist that practice is the only standard for examining truth. Only in this way can our nation's psychological workers thoroughly free themselves from the bonds of idealism and metaphysics, have the courage to correct mistaken views that do not coincide with the actual situation, have the courage to overturn old theoretical views, and have the courage to study the new problems in psychological research presented by our nation's new long march, so that our nation's psychology can better serve our nation's socialist modernization.

II

From the beginning period of the founding of the nation to 1957, our nation's psychological circles studied the Pavlovian method of conditioned reflex

on a widespread basis and used the Pavlov theory of conditioned reflex as a fundamental and major theory for the study of psychology. Conditioned reflex has become an additional research method in psychological research in China. This has a certain significance. But using this kind of method and theory in psychology unilaterally and like a craze has to a rather great extent exerted a discouraging effect upon the continuous exploration of new problems, new theory, and new methods and in efforts to combine concrete practices with thought in China's psychology.

In 1958, the arrow of accusation of the so-called movement to criticize psychology related to methodology was pointed in a direction critical of research using the method of conditioned reflex, which reduces people to dogs and makes psychological research biological in nature. This kind of criticism under the circumstances of the time was not entirely unreasonable. But one kind of onesidedness is replaced by another kind of onesidedness. Thus the class analysis method emerged, and some people believed it should become the principal method of psychological research. Therefore it was believed that in a class society, every human possesses a class character and human psychological states generally possess a class character. All psychological phenomena of man had to be analyzed by the method of class analysis to understand their true nature. Digressing from the method of class analysis would hinder the scientific exposition of the nature of man's every psychological phenomena. The unilateral use of class analysis as the major basic method of psychology is obviously unscientific. The method of research must be determined by the nature of the subject of research. The method of class analysis is the method of studying class phenomena in society and class struggle. Psychology is not a science that studies class phenomena and class struggle, although sometimes they cannot be neglected. Therefore the method of class analysis cannot become the major method of psychological study. Practice proved that at the time the propagation and the singular attention paid to the method of class analysis was a great hindrance to the use of other methods in psychological research, as well as to research and development in the entire field of psychology. More serious was labeling the method as class analysis while slandering other research methods as methods of capitalist class psychology. This greatly inflamed class struggle within the realm of psychology.

Since the founding of the nation, the use of the experimental method in our nation's psychology has had its ups and downs. Since the mid-19th century, the application of experimental methods to study psychology so that psychological studies acquired a new means has greatly helped the development of psychology. Especially in the realms of the senses and consciousness, in learning and memory, experimental methods have made important contributions. Certain methods of traditional experimental psychology are vital to some questions. Since the founding of the nation, some of our nation's psychological research results have been achieved by means of experimental methods.

It should be seen that the experimental laboratory method is an important method of studying psychology but not the only one. It has its limitations. Labeling the experimental laboratory method as unscientific without further analysis is not right. But to exaggerate or regard as absolute the function

of the experimental laboratory method is also inappropriate and even mistaken. At a time of modernization of psychology, we must pay a lot of attention to utilizing modern scientific techniques and means as soon as possible, under the guidance of the ideological line of socialism, to build modernized psychological laboratories that are suited to our nation's characteristics and which are the best in the world. This has strategic significance in hastening the modernization of our nation's psychology and elevating the level of research of our nation's psychology. At the same time, we must pay attention to overcoming or preventing the emergence of the view that building modern experimental laboratories is the only path towards modernization of our nation's psychology, or to even mistakenly believe that the higher the level of the experimental instruments and the higher the price of the instruments, the higher the level of scientific research of psychology. This view is not right and is even damaging. This is because the experimental laboratory method is only one method for studying psychology. Not all research subjects in psychology require the use of laboratory methods.

Even the research subjects in psychology that require the use of experimental methods in the laboratory do not all require the use of large, precise, and pioneering instruments. Some research subjects in psychology need modernized experimental means, and the level of such research work has a definite relationship with experimental means. Without such research means, research work can hardly be carried out. But in such psychological research, the value of the instruments and the value of the results of scientific research simply cannot be equated. The unscientific design of an experiment or unscientific treatment of the results and incorrect ideological guidance will all prevent the experiment from producing the effect that it should produce. Neglecting theoretical thought will make it impossible to obtain an appropriate theoretical explanation from the data obtained. Therefore, the more use we make of large, precise and pioneering modern experimental means, the more attention we must pay to the scientific nature of experimental thought and an explanation of the results.

Because of the different subjects of research of different sciences, different research methods must be used. The method must suit the subject. Therefore the subject of psychological research--the extreme complexity of psychological phenomena--has presented great difficulty to the study of psychology. Thus the study of psychological methodology should be given more attention. Practices over the 30 years of psychology in our nation tell us metaphysical methodology, onesidedness, and an absolutist method of thinking have caused the studies of our nation's psychological methodology and concrete methods to sway back and forth. One side is lost while taking care of the other side, and the part becomes the whole.

To modernize our nation's psychology, we must exert a lot of effort to establish a scientific psychological methodology guided by dialectic materialism.

We must study the significance of the guidance of philosophy, or world outlook, to psychological methodology. We must summarize the experiences

and lessons of philosophy or world outlook on psychological methodology over the 100 years of modern psychology, and in particular we must summarize the experiences and lessons in this regard over the 30 years since the founding of the nation. This is very important in freeing our nation's psychological research from idealism and the bonds of metaphysical methodology and in hastening the steps toward the modernization of psychology.

We must pay attention to the function of theoretical thought in guiding the methods of observation and experimentation in psychology. Observation, experimentation, and theoretical thought are complimentary. Not one can be discarded. Some scientific facts of psychological phenomena can be discovered through observation and experimentation. Theoretical thought can reveal the inner relationship among scientific facts, and a scientific hypothesis can be proposed. In the history of the development of psychology, advocates of rationalism downgrade observation and experiment, and experimentalists neglect theoretical thought. Both are unilateral. The functions of theoretical thought in guiding observation and experimentation in psychological research are very important and should be taken into consideration throughout research. Psychology, like other sciences, and even more so than other sciences, should select its subjects of observation and experimentation, determine its major fields of study, develop the foremost conditions for realizing the modernization of our nation's psychology, and surpass the advanced levels of the world. Theoretical thought will enable psychological workers to become skillful in grasping the forefront of the development of psychology, grasp the points of growth, and correctly select the breakthrough points to open up new directions. How can highly complex psychological activities be observed and studied under simplified research conditions? How should the results that are obtained through observation and experimentation be handled? How can partial and rash conclusions derived from an explanation of experimental results be prevented? All [these questions] need the correct guidance of theoretical thought.

We must study the historical experience and lessons concerning the effect of the development of modern techniques of natural science upon psychological methodology and concrete research methods. Wundt introduced modern scientific experimental methods, mainly physiological methods, into psychology. People regarded them as the beginning of modern psychology. In the 20th century, and especially since the 1950's, modern natural sciences have developed tremendously fast. This has provided a very advantages condition for psychological methodology and the creation of new methods of psychology.

Cybernetics, information theory, and systems theory have opened up a new area of modern scientific methodology. They have made it possible to break through the past situation of breaking down complex systems into simple systems and using simple systems to give a rough explanation of complex systems, and they have sought further for methods more suitable to complex systems to explain complex systems. Psychological phenomena are extremely complex. Man's senses, consciousness, memory, thought, emotion, will, and such psycological processes are a closely connected psychological process that constitutes a whole and are inseparately connected to the

outside world and man's life and practices. In the past, and for the convenience of research, the whole psychological process was divided for study into the senses, consciousness, memory, and so forth. Separating a psychological process from the whole in order to study it, and even isolating the psychological process from the real world, will necessarily cause onesidedness. This is because, under ordinary conditions, simple and pure senses, memory, and emotions that are separate from the entire psychological process do not exist; nor does a psychological process that is isolated from the objective world exist, either. The appropriate introduction of the concepts and methods of information theory, cybernetics, and systems theory into psychological research may have an important methodological significance in studying complex and complete psychological processes from an all-inclusive view.

When introducing the concepts and methods of natural sciences for solving psychological problems, the true nature of psychology and the independent nature of psychology related to its true nature must be correctly understood. Otherwise, one may lose direction.

The author believes that as development in modern natural sciences stimulate development in the methods of making psychological research more objective, we must not neglect the unique function of the method of self-observation in psychological research. Psychological phenomena are different from physical and chemical phenomena. Self-observation is a basic method in psychological research. In particular, self-observation should not be neglected in the study of man's thoughts, emotions, will, and personality (such as character). The method of self-observation and the method of subjectivism must not be equated. Of course, self-observation cannot completely satisfy the needs of psychological research, but psychological research must not discriminate against it. The writer believes that the research methods of making psychology objective and the self-observation method should be appropriately joined together and should suppliment and mutually confirm each other.

The complexity of psychological phenomena determines the multiplicity of research methods in psychology. The various concrete methods of psychological research--such as observation, investigation, summarization of experiences, natural experimentation, laboratory experimentation, and case analysis--do not have any priorities. The nature of the actual research subject must be considered before choosing one or several methods. Basically speaking, the level of psychological research is determined by whether the results of the experiment can stand up to the test of practice and the degree of the objective patterns which the research results reflect. We cannot judge without analysis which is the higher or lower level of research, be it the study of the application of psychology, the study of applied basic theory, the study of fundamental theory, or the study of basic theory. Regardless of the kind of psychological research, the psychological research that coincides more with the actual situation of psychological patterns and that can better solve certain major problems in psychology is the one with the higher level.

Psychological research methods are produced and developed from psychological research practices. Past methods of psychological research, limited by the historical and social conditions of the times, are relative and conditional in their application. Any of the concrete research methods of modern psychology has its scope of application and limitations. Not a single concrete method of psychological research can be made absolute. We must not fear difficulties and dangers. We must have the courage to explore. We must make it possible for the methods of the natural sciences and the methods of the social sciences as methods of psychological research to penetrate each other step by step and to create new methodology and new research methods that better suit the characteristics of psychology, so that breakthroughs can be realized in psychological research methods.

Because of the complexity, multiplicity, and difficulty of the subjects of psychological research, there is more need to advocate that a hundred flowers bloom in research methods along the road of modernization of our nation's psychology so that all kinds of methods may emerge and each reveal its advantages, and finally so that they can be tested by practice and be scientifically evaluated. Artificially elevating a certain research method and artificially downgrading a certain research method are both disadvantageous to the development of psychology. The first and second issues of the JOURNAL OF PSYCHOLOGY in 1979 published some papers on the results obtained by different exploratory paths in psychological research, and an editor's note was written for each to encourage promotion and evaluation. This way of doing things is praiseworthy.

We must travel our own path in the development of our nation's psychology. We must have the courage to create and be skilled at creating, ceaselessly to create new methods, new opinions, new viewpoints, new concepts, new theories, and new contributions in psychology, and finally to complete the establishment of the body of dialectic materialist psychology needed by socialist modernization. This should be the sacred goal which all of the nation's psychological workers should strive toward together.

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REVIEW OF PHYSIOLOGICAL PSYCHOLOGY SINCE LIBERATION

Luda XINLI XUEBAO [ACTA PSYCHOLIGICA SINICA: JOURNAL OF PSYCHOLOGY]
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[Article by Chen Daru [7115 1129 2677] of the Psychology Institute of the Chinese Academy of Sciences: "The Course of Research in Physiological Psychology in Our Nation, and a Retrospective on Some Fundamental Problems" (Comrade Pan Shu [3382 5486] provided valuable remarks on this article)]

[Text] Since the founding of new China, our nation's psychological workers have been guided by Marxism-Leninism and Mao Zedong Thought. A lot of work has been done and there has been a lot of debate,[1,2] concerning how to conduct research in scientific psychology to serve socialism better. The question concerning the psychiological mechanism of psychological activity--i.e., work in psysiological psychology--is also one of the subjects. This article will give a historical retrospect and will comment briefly on several basic questions in psychology on the basis of work in this realm[1] done over the past 30 years in scientific research and practice. To review and comment on the past is to look into the future. It is hoped that this will stimulate a contention of thoughts to further a profound exploration of the questions.

I. The Course Over the Past Thirty Years

(1) Foreword

One aspect of the work during the beginning period of modern psychology was the application of physiological methods to study psychological questions. The work of Wilhelm Wundt in this regard, "Principles of Physiological Psychology" (1873-74), was "an attempt to cut out a new field of science."[2]

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1. This article has drawn upon the research work published in this publication up to the No 2 issue of 1979.

2. Wundt, Wilhelm, "Principles of Physiological Psychology": Foreward of the first edition (translated by Wang Jinhe [3769 2529 0735] and edited by Lin Chuanding [2651 0278 7844]), "Collected Works of the Original Writings of Wilhelm Wundt," compiled and printed by the Working Group to Criticize Wundt, 1978, p 2.

(Heikel) (1889) pointed out: "The serious difficulty of establishing psychology is that the knowledge of the human body must first be learned--especially the understanding of the most important organ of spiritual life, the brain."[3] During the mid-19th century, people believed that "the experimental use of foundations of physiology to explain psychological phenomena to formulate methodology"[4] is precisely the important characteristic difference between scientific psychology and psychology based on philosopical and ideological debate. Since the beginning of this new realm of "physiological psychology" pioneered by Wundt over 100 years ago, physiological psychology has always been an important realm and the direction of exploration and research in scientific psychology. Even moreso, "in reality, the emphasis of modern psychological research is on the physiological mechanisms of psychological activity."

At the beginning of the 20th century, physiological psychology, as a branch of psychology, was also introduced into China from Western Europe. Some psychologists during the early period in our nation also conducted research concerned with pshysiology and thus became members of the Chinese Physiological Society at its inception. They kept in close contact and made definite achievements[1] in the physiological analysis of behavior psychological states as well as in the research of the structure and function of the cerebral cortex. Foreign commentators on psychology did not pay attention to these achievements, and thus there were no comments concerning these types of work in our nation.[2] In fact, since liberation, physiological psychology, or the study of the physiological mechanisms of psychological states, has alwyas been the major direction of our nation's research in psychology.

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3. N. (Heikel), "Secrets of the Universe," Shanghai People's Press, 1974, p 85.

4. "Selected Works of (Shechinov), "People's Public Health Press, 1957, p 91.

1. (a) Lu Yudao [4151 0060 6670], Test Tube Measurements of the Function of the Cerebral Cortex, CHINESE JOURNAL OF PSYCHOLOGY, Vol I, No 3, 1937.

   (b) Guo Renyuan [6753 0117 6678], Development of Embronic Activity of Birds, Bimonthly Journal of Psychology, Vol 1, Nos 1 and 2, 1934

   (c) Wang Jinxi [3076 2417 3356], Physiological Analysis of Behavior. Independent Press, 1944.

2. Chinese-American Robert Chin and Alice Shen, Psychiological Research in Communist China: 1949-1966. MIT Press, 1969. The book has 274 pages and 7 chapters: Introduction, Professional Development, Medical Psychology, Industrial Psychology, Educational Psychology, Characteristics of Morality and Individuality, and Conclusion and Prospects. There is no chapter on physiological psychology.

(2) Work Over Three Periods

Looking back over the past 30 years of research in physiology and psychology in our nation, there are three periods of major work, described as follows:

1. Psychological and Physiological Research in the Higher Neurologic Activities, and Comments

At the beginning of the 1950's, we learned Soviet psychology and tried to follow the direction indicted by Lenin, who said scientific psychology "abandons the philosophical theories concerning the soul and directly studies the material body (the nervous process) of psychological phenomena.[2] The theory of Pavlov's higher nervous activity and the method of conditioned refelx were applied in the study of psychology to explore the physiological mechanism of psychological states as the beginning and the direction of our nation's efforts to establish scientific psychology. The major work during this period, using animals as subjects, included methods to differentiate alternating differences in long and short distances, ability to analyze musical tones, recognition of pictures, and related reflexes. The major work involving humans included mutual communication of two kinds of signal systems, the order of reactions of establishment of motor movement, charateristics of the functions of communication and, later, age characteristics of comprehensive conditioned reflex and delayed conditioned reflex, and comprehensive activity of the cerebral cortex of normal and abnormal children. Clinical research included exploration of motor characteristics of the cerebral cortex in victims of neurastheria.

These studies, with the exception of a few that were conduc d later by Chinese who were educated in the Soviet Union, were mostly the work of the early period of the Psychology Institute (the psychology research laboratory). Our nation's psychologists at the time made appropriate comments concerning such work. These studies "were mostly important experiments that proved the theory of Pavlov, but there were few creative experiments." Some comrades believed that man's psychological activity and nervous types were extremely complex subjects of research. It was not enough to rely only on a simple conditioned reflex in the laboratory to conduct research; various different research methods must be used." In the debate on the basic question of psychology that began in 1958, some pleople blamed the trend of "turning" psychology "into a biological science" of Pavlov's theory, while some believed mistakes in psychology were due to the "mechanical viewpoint" of nervous activity. After the debate, people still believed that Pavlov's theory of higher nervous activity is the natural science foundation of psychology," and that the higher nervous activity established by Pavlov is consistent with the physiology of the conclusions of dialectic materialism." Yet it can be clearly seen that in the study of the physiological mechanism of psychology, "Pavlov's theory of conditioned reflex is undoubtedly a strong weapon, but the method of conditioned reflex is not the only method of research in psychology." Therefore, some people proposed that research in psychology must necessarily further combine pioneer international scientific theories and techniques of the time--such as cybernetics

information theory, electronics technology, electronic computing technology--and develop exploration of the physiological mechanism of psychology or the material body of psychology from many directions.

2. Research in Physiological Psychology Using Electronencephalography and Dermometry as Major Indicators; Its Rise and Fall

At the beginning of the 1960's, the scope of research widened because of the introduction of new scientific theories and techniques. Some people explored the question of simulating psychological processes, and it was a pity that the work was not continued. During this period, more work was done on the research of physiological psychology using electroencephalography and dermometry as indicators. More systematic research was conducted in electroencephalography using mainly "electroencephalograms of Chinese people." Over 1,000 persons were tested, including persons of different ages (babies to a 110-year-old-man), different subjects (normal adults and children, blind, dumb and retarded children), and different aspects (basic electroencephalographic surveys, primary reaction, rhythmic assimilation). More detailed analysis was done in the study of the age characteristics of brain development of children between 4 and 7 years old and from 8 to 20 years old, as well as the electroencephalograms of children of retarded growth. It was discovered that the electroencephalographic rhythms of children between 5 and 6 years old and between 13 and 14 years old showed a definite "jump." The electroencephalograms of mentally retarded persons are abnormal. Those of idiots are most obvious, followed by those of dementia, and those of the slow-witted were not too obvious. The researchers also studied some of the relationships between brain waves and intellectual activities (such as mental arithmetic exercises); they combined electroencephalography and dermometry to explore directional reflexes of the "nervous model"; they combined information theory and cybernetics to study whether the brain simultaneously received signals from two channels (seeing and hearing); and they studied the distribution of attention. In clinical practices, studies were conducted into the relationship between the α-rhythm and the process of excitation of the skin of patients being treated for neurathenia, the effect of emotional language upon the patient's electroencephalograms, and the relationship between self-conscious symptoms and dermometry. The functional schizophrenia and the physiological mechanisms of psychological states were explored from the viewpoint of neuropsychology by studying inidivudal cases of patients who suffered from reading disorders after undergoing brain surgery (to remove a left superior sagittal arterial tumor). In addition, some people explored questions concerning the relationship between the differences in electrical potential on the body surface and the degree of tension of psychological activity, and the activity of the blood vessels of the skin and attention (deep breathing "concentration"). During the beginning of the 1950's and 1960's, some people studied and tested the physical development of children and their gripping strength and published their results during this time.

Compared to previous years, the scope of research in this period expanded and the subjects and research methods increased in variety. Some work (such

as age characteristics of electroencephalograms of children) also achieved definte results. Yet during the mid-1960's, when physiological psychology was being launched in many aspects in the manner of "a hundred flowers blooming," Yao Wenyuan and the "gang of four" began interfering with and sabotaging psychology. Research in physiological psychology also became a target of attack. They used ignorance to oppose science and sold "the theory that the spirit is omnipotent," flagrantly twisted Marxism, and negated the materialist foundations and patterns of spiritual activity. Under this pernicious influence, some people even said psychiatric patients were "patients suffering from the disease of a lack of Marxist-Leninist thought." Psychological science was called a capitalist pseudoscience and was thus supporessed. These ridiculous theories were criticized only after the "gang of four" was defeated.

Research in physiological psychology required certain facilities, techniques, and data. After 10 years of interference and lack of continuity, it was greatly damaged.

3. Part of the Work Presently in Progress--Acupuncture Anesthesia Research and Research on Chemistry of the Brain in Physiological Psychology

During the second half of the 1970's physiological psychology again was given new life. At present, much work is being done. For example, in studying the mechanism of the brain, research is being done in the chemistry of the brain with regard to memory and learning. Clinically, some people resisted all kinds of interference and persisted in coordinating the entire nation's research in the mechanism of acupuncture anesthesia. They explored and confirmed the connection between psychological factors (especially emotional states) and some physiological indicators (dermometry, breathing, pulse) and their functions in acupuncture anesthesia. They explored the rhythm of annual cycle of the thresholds of skin pain and believed that within the annual cycle, the sense of pain is duller in spring and autumn than in summer and winter. In addition, comparative examinations were conducted using electroencephalograms in the study of intellectually retarded children. In studying children of advanced intelligence, the electroencephalogram was also used in individual cases as an indicator to determine brain development.

(3) A Brief Summary

The following impressions can be derived from a general review of the history of development of physiological psychology and the work done in this area during the past 30 years since founding of the nation: 1. Physiological psychology is the important starting point, the realm, and the direction of research that differentiates scientific psychology from psychology based on ideological debate (the psychology of ancient philosophy). 2. Ever since psychology was introduced into China from Western Europe, our nation's psychological research has always persisted in the research into new realms and new directions. 3. After liberation, China's psychological workers with even more self-awareness took this realm as the starting point to establish a modern psychological science and regarded it as a subject of

research which could not be done away with. They expanded the scope of research from the use of conditioned reflex in the 1950's to electrophysiology in the 1960's and chemistry of the brain in the 1970's, ceaselessly introducing new theories and new techniques. 4. Research in this realm not only is necessary in profoundly exploring the material body of psychology, but its use in education, physical education, and medicine is gradually expanding. 5. Much work in this realm is still beginning, but it already possesses our nation's national characteristics (such as acupuncture anesthesia and breathing exercises) The achievements are not yet withstanding; some are rather scattered; some are still blank; some need to be studied in depth and become more advanced. 6. In certain areas of research, more emphasis is placed on experimental observation, and exploration of theory is still weak. Many problems still await further exploration to clarify the direction for big strides foreward.

II. Reviewing Several Problems

Over the past 30 years, many basic problems being debated within our nation's psychology circles are related to physiological psychology or the physiological mechanism of psychological states. Several problems mentioned in the following [pages] as areas for further explanation.

(1) Working Policy of Psychology

At the beginning of the 1950's, we took the "psychology which was newly established as a science, reformed on the basis of Pavlov's theory, and which followed the guidance of Marxism" as the "already established task policy." This policy elevated Pavlov's theory to a position parallel to Marxism. This was mainly the result of the resolution adopted at the joint conference of the Soviet Academy of Sciences and the Soviet Academy of Medical Sciences (abbreviated "the two scientific academies") in 1950. The resolution said: "Pavlov's outstanding scientific achievement...has created a firm foundation for natural science in the direction of reforming the medical and psychological sciences." In fact, regarding Pavlov's theory as the only natural science foundation of psychology was a reflection of historical facts of the early work in our nation's psychology. As described above, during the latter half of the 1950's our nation's psychologists repeatedly pointed out the limitations of Pavlov's theory as simply one school of thought and one method. They began to break the trend of following only one school of thought and introduced various new theories and new techniques, with the result that beginning in the 1950's, physiological psychology began to flourish. In 1962, the two Soviet scientific academies again held an enlarged meeting and poiated out that the 1950 meeting "has caused many serious and discouraging results. The major result was that the dogmatic attitude of Pavlov's school of thought got the upper hand," and [there emerged] "a trend of vulgarization--regarding psychological research as the research of higher nervous activity by physiological means, neglecting the unique methods of psychology." This discouraging result also seriously occurred during the early 1950's in our nation.

Practice proved that the policy of reforming psychological studies based on Pavlov's theory during the early period in our nation had already accomplished its historical mission. To suit future work, we need new policies. That is: "Under the guidance of Marxism, advanced scientific theory and techniques should serve as the foundation and the means for the establishment of modern psychology." Here, "advanced scientific theory and techniques" include new achievements of Pavlov's school of thought and other Soviet schools of thought which are still developing, and also the active results of Western sciences (natural science and social science). So-called "modern psychology" must be a kind of "psychology which possesses socialist characteristics, which implements the viewpoint of dialectic materialism, which absorbs all active achievements of psychology of our nation and of foreign nations and of the past and of the present, which uses advanced techniques and means, which suits the demands of our nation's four modernizations, and which possesses our nation's own body of theories." This is the new policy of work provided by the new historical period for our nation's psychology. "Such a change should be the major goal of our efforts."

(2) The Task of Linking Psychology With Reality

This was the "greatest schism" in the psychology debates during the latter part of the 1950's. There were mainly two different opinions, the so-called "school of refelctive processes" and "the school of conscious trends," or "physiological mechanism school" and "social limitations school." The former emphasizes linking psychology with reality by studying the reflective process and its patterns, and takes the study of physiological mechanisms that expose psychological phenomena as the future course for linking theory with reality. The latter emphasizes that the task of linking psychology with reality rests in studying man's psychological states, how consciousness is formed and how it develops in social practices, and all the patterns related to how it develops its dynamic functions. The former emphasizes that the study of psychology is mainly to provide a scientific basis for Marxism's theory of knowledge. The latter emphasizes the major task of serving moral education of the proletariat ideology. In fact, the two tasks differ only in their different emphasis. They both have their own necessity and importance in socialist construction which cannot be neglected. In the research of "reflective processes" and their "physiological mechanisms," according to the above research over the past 30 years, it can be seen that research in physiological mechanisms not only has important significance in such important theoretical questions as "how the brain produces consciousness," but it has also expanded its function in linking with practice in education, physical education, and medicine. These constitute an indispensible field of work. But it is also wrong to see only the importance of the work in these areas and overly inflate it or unilaterally emphasize it, and thus neglect or avoid work in the other areas. Viewing the entire body of science, in particular one must not consider the study of reflective processes and their mechanisms as belonging purely to natural science and completely neglect or eliminate the study of social factors. At the end of the 1950's some people had already pointed out their confirmation of the preliminary achievements of the study of reflective processes as a branch

psychology, but from the point of view of natural science: "In fact, if duty calls, I believe a new field should and will necessarily be opened up. Speaking affirmatively, many human sciences having the characteristics of social science will have a great future for development." The reason is that "the subject of psychology and man's own psychological states are changed and developed in the course of social history, and therefore the study of psychology cannot remain absolutely unchanged." Practice has proved that this viewpoint reflects an important side of the truth. If we say that for the past 30 years our scientific research practices did not sufficiently emphasize man's social character, or that such practices neglected man's social character, then the demands of today's four modernizations have already presented an urgent demand upon the study of social psychology. The significance of studying the social nature of psychology has already far superseded the scope of moral education and is closely related to modern politics, economics, and culture. Studying social psychology or social limitations of psychology are the needs of the present task, and thus, this ancient yet young (or shall we say nearly blank at present) realm will surely have a future development, like physiological psychology or the study of physiological mechanisms of psychology.

(3) The Interdisciplinary Nature of Psychology

At the beginning of the 1960's, the Psychology Institute seriously discussed this question and concluded in the summary of 3 years of experience, "We should emphasize the interdisciplinary nature of psychology and take it as a guide for the direction of our work and tightly grasp this characteristic nature of psychology. This means studying psychology's natural nature and also studying psychology's social nature. The important thing is to study the realtionship of dialectic unification of these two natures so that research results can more truly reflect the characteristics of the nature of psychological phenomena." Later, Comrade Cao Richang [2580 2480 2490] wrote a theoretical generalization of the long period of scientific research practices and used the textbook of general psychology compiled in our nation as an example to show that "because of its basic view of 'naturalism'...and its lack of understanding about the dependent relationship of psychological processes upon social practice, psychology for a long time remained subsidiary to the 'biological outlook' and could not resurrect itself." Here he linked the viewpoint of "natural man" of the history of science with the unilateral empahsis on the natural aspects of psychology and the tendency to oversee psychology's social roots in our psychological research; he called it "naturalism." He affirmed the dependent relationship of psychology upon social practice, and he said: "Psychological processes also have their social roots, which cannot be understood by studying physiological mechanisms. Failure to understand the roots of psychology in social practice will result in inability to obtain an overall understanding of the developmental patterns of psychological processes." Therefore he concluded that "one of the characteristics of psychology may be the combined use of methods of social science and natural science to study the psychological phenomena that are dependent upon social practice." Here, we see that his emphasis upon the social roots of psychology has given people

the mistaken impression that psychology and "physiological mechanism" are opposites and do not have unity. To overcome the inclination towards naturalism, he correctly pointed out that the social roots of psychology and the pragmatic nature of society must be studied by combining methods of social science and natural science. This new recognition possesses a very important theoretical and practical significance. In recent years, it can be clearly seen that the social nature of psychology is being greatly emphasized in international psychological circles. For example, the famous Soviet neuropsychologist (Luriya) empahsized in his article "The Humand Brain and Conscious Activity" the work of (Vegotskiy) (founder of the theory of social culture as a branch of early Soviet psychology) and opined: "Consciousness is a kind of complex neuropsychological and structural system possessing semantic function." He stated in his autobiography (1974), summarizing his life's work in psychology: "To scientifically understand the origin and history of man's higher psychological functions, one must break away from the naturalist analysis of psychological phenomena." Here, he also mentioned the question of "naturalism." And furthermore, he viewed the emphasis on the social and historical nature of psychological functions as "a new path of development of psychology." A British neurophychologist pointed out in his book, entitled "The System of the Brain and Concepts of Psychology," which expands the complex relationship between the brain and consciousness with massive amount of experimental data: "The moldability of the nervous network and the revision of behavior are fundamental human characteristics....When culture emerged, we entered into a new evolutionary nonbiological situation. Through technical progress, we have strengthened and perfected our adaptability. Through social and cultural progress, we have expanded our consciousness." Here, they have all expressed in principle the character of the unity of opposites of human psychological functions or nervous processes and the development of society and history. Thus they have proved the necessity for "the combined use of methods of social and natural sciences to study the psychological phenomena that are dependent upon social practice."

The question how the natural character and social character of psychology should be handled, as seen from the history of psychology, is a lengthy process of recognition. Between the end of the last century and the beginning of this century, Wilhelm Wundt used "experimental psychology" and "national psychology" to separately study the lower and the higher processes of psychological states. During the 1920's, the "dialectic materialist psychology" proposed by (Kernilov) basically followed the simple method of dividing one into two and used the research of "reactology" to study natural reactions in human psychology and "class psychology" to study man's nature as "the sum of social relations." This did not solve the problem. Our nation's representatives of behaviorism simply regarded psychology as a natural science and completely negated the social nature of psychology. They openly advocated that "the mission of behavioral science is to mechanize, consolidate, experiment make psychology into a physical science and reduce psychology to a physiological state."[1,2,3] This idea seems now to be somewhat ridiculous, but this is precisely an extreme manifestation of "naturalism." Today, psychologists all recognize that

while emphasizing the study of the physiological mechanism of psychology, the social nature of psychology should not be neglected. Therefore they have proposed that "the naturalistic analysis of psychological phenomena should be broken," and that "the combined use of methods of social and natural sciences be used to study psychological phenomena which are dependent upon social practice." One cannot deny that this is a big step forward in recognition, and it has important significance in present scientific practice. To insist on the interdisciplinary nature of psychology, to emphasize the natural character of psychology simultaneously with emphasis on the social character of psychology, and to place research of this social character on the present agenda of research work constitute the new path of development of present-day psychology and the new direction of development of linking the field of physiological psychology with reality. Only by gaining an overall recognition of the true nature of psychology by using the viewpoint of this kind of dialectic materialism and by using the method of closely combining natural and social sciences can there be hope that someday the secrets of psychological mechanisms can be totally exposed through research.

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1. Concerning the relationship among "psychological functions," "physiological mechanisms" and "neurological processes," Comrade Pan Shu believes: "Many of the physiological mechanisms of psychological activity that we frequently talk about are actually neurological processes that compose the psychological functions. They are the 'material bodies' of psychological activities."

2. Pan Shu, Talking About Psychology, EDUCATIONAL RESEARCH, No 2, page 77, 1979.

3. Guo Renyuan [6753 0117 6678], Foundations of Behaviorism, COMMERCIAL PRESS, page 9, 1929.

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REVIEW OF INDUSTRIAL PSYCHOLOGY SINCE LIBERATION

Luda XINLI XUEBAO [ACTA PSYCHOLOGICA SINICA: JOURNAL OF PSYCHOLOGY] in Chinese No 1, Feb 80

[Article by Peng Ruixiang [1756 3843 4382] of the Psychology Institute of The Chinese Academy of Sciences: "Thirty Years of Industrial Psychology in China"*

I

[Text] Western industrial psychology was introduced into China at the beginning of this century. In the mid-1930's, the number of articles introducing topics related to this subject increased. At the same time, there were some psychologists who conducted quite a number of research projects in this regard. But because industrial psychology of the West at that time was not given much attention by plant owners and it was not welcomed by the masses of workers, industrial psychology did not take root in China for a long time.

After the founding of new China, the working class became the masters of the enterprises. Developing production and accumulating more wealth for the state became the unified demand of the people of the whole nation. New China's industrial psychology thus developed strongly under this premise.

II

During the period at the beginning of the 1950's the Psychology Institute of the Chinese Academy of Sciences was established, a plan was proposed for the development of industrial psychology. But because the direction of the task was unclear, active achievements did not materialize. Beginning in 1953, the Psychology Institute entered a period of learning and reformation. During this period, the workers of the Psychology Institute conducted theoretical research in the "order of reactions in the establishment of motor movements," based on learning the Pavlov school of thought, in an attempt to explore the physiological mechanism of learned skills.[1] At the beginning of 1957, the Psychology Institute of the Chinese Academy of

* Industrial psychology includes part of the content of engineering psychology.

Sciences established an industrial psychology group. Immediately afterward, a survey of problems concerning waste and accidents in factories and mines in Beijing, Tianjin, Shenyang, Changchun, Harbin, and Shanghai was conducted jointly by that group and the concerned units of the First Ministry of Machine Building. A preliminary analysis[2] of the causes of such incidents was done on the basis of the material gathered. At the beginning of 1958, the industrial psychology group was expanded and joined with concerned units of the First Ministry of Machine Building to jointly sponsor a research class in the rationalization of operations. Over 70 cadres in factories and mines participated in lectures and promotional talks on industrial psychology. This created the condition for research into industrial psychology in actual production. In 1958, in the mass movement to engage in technological renovation and creation in a big way, our nation's industrial psychology workers went to the places of production and worked closely in actual situations to study ways to improve the methods of operation,[3] conduct training of technicians,[4,5] and promote technical creativity activities,[6-9] and they achieved preliminary results. The work of this period has its shortcomings, and some digressions were made: 1. The policy of linking theory with reality was insufficiently understood. As an institute of psychology of the Academy of Sciences, linking theory with reality should mean grasping the key comprehensive problems in actual production, and research should be conducted according to plan and step by step. Linking theory with reality does not mean throwing oneself into actual production to solve individual and scattered practical problems. The understanding of linking theory with reality should be to discover problems in actual situations, to determine the tasks, and to combine laboratory research in an effort to solve problems in actual production and to elevate the level of the scientific subject of the particular science by a solution of such problems and by repeated efforts to combine research with actual situations. 2. During this period, research workers often became satisfied with solving individual tasks, such as raising the labor efficiency of one production flow line and improving the methods of operation of individual workers. Using this method to conduct research definitely created a situation of "troubleshooting all over the place in an unorganized fashion," and it was thus difficult to solve key comprehensive problems in actual production.

After our nation's practioners of industrial psychology summarized the lessons and experience of this period, they "gained widom by learning a bitter lesson." From 1962 to 1966, the period between the time when our nation's national economy followed the correct policy of "readjustment, restructuring, consolidation, and improvement" to the beginning of the Cultural Revolution, our nation's practicioners of industrial psychology, like the people of the entire nation, overcame all difficulties with a strong will under the party's leadership. In a stable situation and an environment with a stronger academic atmosphere, they exerted efforts to revive the laboratory research work that had once ceased, and the work of linking theory with reality was launched in a new understanding. During this period, the quality of research, generally speaking, was greatly elevated. If we consider the work prior to the 1960's as "training" for

our nation's industrial psychology workers, then some of the work launched after the 1960's can be said to have achieved active results.

During the 10 years of the Cultural Revolution, which began in 1966, our nation's industrial psychology, like all other sciences, suffered from sabotage and destruction by Lin Biao and the "gang of four." Some research subjects were scrapped soon after they were started. Some research achievements that were about to be published were forced to cease. Research work, after 10 years of inactivity, revived after the psychology institute was reactiviated, and our nation's psychological workers again actively took up the task of studying subjects proposed by concerned departments. Under difficult conditions, the support and cooperation of concerned units were sought and within a short time some achievements were made. Achievements which have been realized after 1962 and after the Psychology Institute reopened in 1972 are the following:

1. Research in Railroad Signals

In modern production techniques, man and machine form a unified man-machine system. In this system, man, who acts as the receiving channel, is the central link of this system. The operator depends on his own sensory organs to receive signals of changes in the production process and in the operating state of the machine. These signals are processed in the brain, a judgment is made, and finally man exerts control by performing operational maneuvers to control and regulate the machine. An important aspect of research in engineering psychology is how to suit the design of signals and operating installations to the characteristics of man's senses, thoughts, and motions so that the man-machine system can be a safe and highly efficient system. Our nation's industrial psychology workers conducted a series of studies concerning the problem of railroad signal lights because of an actual production need during the early 1960's. These included a series of studies in the selection of the frequency of flashing signals,[10,11] the problem of the semantic interference of flashing signals,[12] and the effect of the light apron upon recognition of continuous flashing signals.[13] These efforts provided the railway department with scientific data. The following regulation was issued, based on the suggestions concerning the selection of frequency of flashing signals: the frequency of rapidly flashing lights should be about 160 flashes (per minute); slowly flashing light should have a frequency of between 55 and 60 times (a minute). The rapidly flashing light's light to dark ratio was set at 2:1, and the slowly flashing light's light to dark ratio was set at 1:1. Also, a table of equal differentiation values for flashing signal light frequencies was set up according to the experiment data. This provided a means of convenience for the selection and use of flashing light signals for practical departments. Research in semantic interference proved that when the speed of the flashing color light and its representative speed are consistent, the best plan for coding is to use rapid flashes to designate fast speed (of travel), slow flashes to designate slow speed, and a fixed light to designate even slower speed. This is because such designations coincide with the daily thinking habits of man. When there is a light apron, research indicated that flashing

signals cannot be used at the same place. This was the answer that was provided by research to the departments engaged in the actual work. This means that the light apron interferes with the recognition of flashing signals. It was suggested that flashing signals should not be used with a light apron.

Another project related to signals was the study of colors for railroad signal lights. After liberation, our nation's railroad signal lights used a five-color system, and for a long period there was no standard color guide. The color of the signal lights was not uniform, clarity was poor, and these affected the safety and efficiency of railroad car operations. In 1959, the railway department developed different-colored glass for the signals. Recognition experiments were conducted at 19 railroad maintenance sections of 11 railroad bureaus, involving over 1,200 locomotive engineers and railroad personnel. In 1960, a standard (draft) at the ministerial level was drawn up and was promulgated by the Railway Ministry. Between 1966 and 1969, massive signal color recognition experiments were again conducted for a revision of the standards. Between 1973 and 1979, research in signal colors for the railroads began again to establish standards for the ministry. Experiments were conducted at seven railway bureaus. A total of 1,457 people participated in the experiments. Most of them were locomotive engineers and signal operators. These have provided scientific and experimental data[14] for the Railway Ministry to perfect its signal color standards.

2. Research in Signals in the Central Control Room of Power Stations

Centralized control of weak electrical units in a central control room of a power station is a relatively new technique. It has both economic and technical advantages. The central control room is the heart of the operation of the entire power station. The operating conditions of various machinery are all reflected on the screen in the control room. The operator on duty operates various signals according to what is shown on the screen. As a result of research and experiments from the point of view of engineering psychology, and from surveys and experimentation at actual localities, workers of the Psychology Institute have proposed the following principles for the design[15] of signal representation in power stations with centralized control of weak electrical units: 1. Signals should be directly visible. The reflection screen currently being used for centralized control signals of weak electrical units are directly visible, but there is still room for improvement. If certain analog signals and verbal instructions could be combined, than an even stronger direct visibility would be possible.
2. Signals should be appropriately concentrated, and the area of the screen should be made smaller. To raise the work efficiency of the operator on duty, the arrangement of various signals should be more centralized.
3. Signals and operating components should be closely coordinated. The principle of the suitability of stimuli-reaction should be followed. Each operational activity should be indicated by a feedback signal. This is very important from the safety point of view. This work was one of the achievements shown at the exhibit research achievements of water conservancy and electric power sciences in 1965. The arrangement of the screen of the

centralized control room of a simulated power station operating on a 1:1 signal ratio and built by the Psychology Institute provided a reference for the design of the central control rooms of some power stations in our nation.

3. Studying the Visual Problems Associated with Standardized Lighting

Lighting construction and vision are closely related. This is also one of the subjects of study of traditional industrial psychology. Related data of foreign nations are not necessarily suitable for our nation. Therefore, our nation's psychological workers conducted research[16] related to the problem of standard lighting in ordinary middle and elementary school classrooms in response to actual needs during the mid-1960's Results of the experiments suggested that, taking into consideration the cost of construction and the protection of the vision of young people, the brightness of student's desk tops should be 80 lux (meter-candle) and this should be taken as the basis for the design of classroom lighting. Concrete data were also provided for artificial lighting.

In compiling the brightness standards for the nation's industries and enterprises, our nation's psychological workers also participated in research. Based on massive on site surveys and measurements, a series of experimental research projects on the visual functions of the Chinese people was completed. The results show that under the same level of lighting, a supplementary relationship exists between the visual angle and contrast, i.e., the visual angle can be made smaller by increasing contrast, and contrast can be lowered by increasing the visual angle. Under the same probability of correct recognition (95%), increasing lighting reduces contrast. This is most obvious when the lighting is low and the visual angle is small. Under the same contrast value, increasing lighting reduces the visual angle. Results of the experiments also proved the "reduction law of effectiveness of lighting." This law was used to suggest that in classifying work concerned with vision, the classification should be finer for processing objects of small dimensions and it should be larger for processing objects of larger dimensions. This classification not only raises the lighting requirements for precise work but also satisfies the goal of conservation of electricity. Based on the experimental results proving that dark colors and black backgrounds are unfavorable to visual recognition, it was suggested that in establishing lighting standards, for places of production where there is a dark-colored background and where the reflection of light is low, the lighting should be brighter.[17] Based on the experimental results of the effect of variations of brightness of the visual field upon visual perception, it was suggested that in establishing the standards, a 20:1 brightness ratio be used.[18] In addition, based on the result that within the range of brightness of 1 to 100 lux a different light source does not greatly affect visual recognition it was suggested that in establishing brightness standards, the same brightness values can be used for different light sources. The data provided by this research project have provided an important basis in visual psychology for concerned departments in establishing standards of brightness for lighting in our nation's industries and enterprises.

In addition to the achievements in the three aspects described above, other research, such as the study of the effects of anaerobic conditions on plateaus upon the function of the brain[19] and the effect of the thickness, length, and spacing of graduations on electric switchboard meters upon reading speed and accuracy[20] all have definite practical significance. The former provides reference for concerned departments in dispatching workers to work in plateau regions above sea level. The latter provides data for concerned departments in designing graduations on instruments.

III

"Studying the old enables one to learn new things" indicates that a preliminary summary of the achievements in the aspects described above can perhaps benefit future research. First, the selection of these research topics is to a definite degree within the scope of the principle of providing a solution to key comprehensive problems in actual production. The selection of railroad signals assures safe operation of railroad cars and is an extremely important measure. Questions on how to select the best way of setting up the signals and to determine the degree of tolerance of color standards for colored lights are important questions for the communications and trasnportation departments. Our nation's industrial psychology workers have conducted a quantity of experimental research and have provided valuable data and made valuable suggestions to actual departments. Again, for example, establishment of brightness standards for industry and enterprises, consideration of visual factors, and establishment of a brightness standard suitable to our nation's actual situation satisfy the need of all types of production shops and also achieve the goal of conserving electricity. This is surely a subject which has widespread significance. Second, these research projects have basically achieved implementation of the policy of linking theory with reality and have enriched the content of the academic subject through completion of the task. The research project concerned with flashing railroad signals has provided a preliminary precursory example. By solving the actual problems, a theoretical exploration of questions concerning the sensing of time and the phenomenon of illusory motion was conducted.[21,22] Again, for example, in the work to establish a brightness standard, a big step in the direction of theoretical exploration was taken by utilizing experimental data on the visual functions of Chinese to formulate a mathematical model of the visual function. Third, these research projects preliminarily realized a combination of research in the field and research in the laboratory. A lesson had been learned during the first 10 years of work in industrial psychology. Laboratory research ceased completely. The result was that the level of research was not raised and theory could not be summarized. Generally speaking, the three points mentioned above may be instructive in future work.

IV

During the past 30 years, our nation's research in industrial psychology has already acieved definite results, and about 40 papers have already been published. Comparing the achievements during the past 20 years with

those during the first 10 years shows that even though research during the past 20 years suffered from the destruction and sabotage by Lin Biao and the "gang of four," the achievements made during the past 20 years have been far greater than those of the first 10 years. This shows that our nation's industrial psychology has already grown from infancy into adulthood. The team of workers has expanded and the level of reach has been raised. Some research work were not far behind international levels at the time of comparison. At the beginning of the 1960's, the concept and methods of information theory had already been applied in engineering psychology research. This was also reflected in our nation's industrial psychology research. For example, during the beginning of the 1960's, some researchers used the methods of information theory to study the problem of the suitability of stimuli-reaction.[23,24] Some researchers used this method to study the problem of semantic interference.[25]

In retrospect and in looking at the future, the following three points are worth considering:

1. Persist in the direction of linking theory with reality.

Production is the greatest motive force for scientific development. This is especially true in industrial psychology. As mentioned above, more work has been done in industrial psychology research concerned with signals during the 30 years since the founding of the nation. This indicates that our nation's industry, its communications and transportation industries, have already developed to the stage where they require industrial psychology to serve them. On the other hand, this shows industrial psychology can solve the problems presented by the actual operational departments. As the entire nation marches toward the four modernizations, it can be foreseen that more and more subjects will emerge as problems for industrial psychology to solve. As long as our nation's industrial psychology workers persist in the direction of linking theory with reality, go to the sites to conduct surveys and gain an understanding of the situation, and have the courage to take up the subjects presented by the production departments, the work of industrial psychology will have a bright future. As Chen Li mentioned in his article "Engineering Psychology Marches Toward the Four Modernizations,"[26] in the four modernizations the central link is increased productive power. Engineering psychology will make active contributions.

2. Look at future subjects of research.

In the past 30 years, our nation's industrial psychology workers have conducted different aspects of research. Given the premise of taking care of present needs and preparing new subjects for study, what areas of study should be pursued in depth on the presently established foundations, and what work should be prepared for study? It is believed the following subjects should be continued: 1. Research in industrial psychology can provide the necessary data and a scientific basis for the drafting of various standards relating to the study of work efficiency. This is especially true with regard to standards closely related to man's senses such as vision--standards for

brightness, lighting, and color--and touch--quantitative standards involving touch and motor senses. 2. The problem of psychological selection was preliminarily studied by our nation's industrial psychology workers, and some results were obtained.[27] This question was later "banned." Individual differences among men exist objectively. Different professions, especially certain special types of work, require certain psychological qualities. This is also an objective and real need. Our nation's industrial psychology workers should liberate their thought and develop research in this regard according to plan. 3. The question of how the design of signals can be adapted to man's consciousness, thought, and operational characteristics--or more generally, the question of the suitability of stimuli-reaction--is one on which our nation's industrial psychology workers have conducted some research and have already obtained relatively visible results. This should be continually studied further in depth by linking theory with reality on the already existing foundation. 4. A Xu Liancang [1776 5114 0221] pointed out in his article "The Four Modernizations Need Psychology,"[28] these include psychological questions in production management, such as wage system, system of rewards, and welfare system; how can spiritual encouragement and material incentives be combined well under the actual situation in our nation; and what measures can be taken to develop effectiveness. These questions may be foreign to our nation's industrial psychology workers, but they are fresh questions which have real significance. Necessary attention should be given to these subjects, and exploratory research should be conducted in cooperation with concerned departments. 5. The question of man-machine interface in engineering psychology is not an outstanding subject at present. As our nation's industrial production becomes semi-automated and automated, questions concerning this aspect will be brought out. However high the level of automation, man is still a necessary link in this system, especially in operations of monitoring signals and reconnaissance photography. Man possesses the superior qualities of strong adaptability, quick learning, strong reaction, and a good visual system. These are qualities which the computer cannot match. Therefore, in man-machine interface, the questions of how to select suitable people to do different types of work and how to objectively determine and measure these psychological qualities are subjects which await further exploration by industrial psychology workers.

3. Acieve improved research methods, means, and measures

Generally speaking, past work shows that methodology and measures still remain at a general level. Continuing in this way will make it difficult to precisely expose and reflect the characteristics of the process, and it will be even more difficult to summaraize a theory. It seems necessary to utilize modern instruments and equipment with purpose and a plan. For example, the question of the loci of eye movements in the process of reading and observation, and how can such loci be objectively recorded, is a topic not only of long-term interest to physiologists and psychologists but also constitutes knowledge needed by some engineers involved in simulated recognition in recent years. The techniques used in the past, such as photography, mechanical, and even optical methods, all have certain shortcomings. The subject of experiment feels uncomfortable and the mechanical nature of

the eye is changed. Recently some people have used a noncontact method. A television camera and a microcomputer have been used as a system for recording images. This not only accurately records the loci of the eye movement but also records the order of eye movements. On the other hand, raising the caliber of the researchers and utilizing new measures may also elevate the quality of research. For example, people involved in artificial intelligence have used the so-called "thinking out loud" method. The subjects of the experiments were asked to say out loud every step they take in the curse of solving a problem, whether the step is right or worng. This is an externalization of the thoughts of the experimental subjects. The experimenters using this method were able to systematically analyze in detail the entire process used by the subjects of the experiment, when they were solving a problem, and a flow chart of problem solution was drawn from the experiment. It seems that the achievement of improved methods, means and measures of research constitutes an important task facing our nation's industrial psychology workers.

FOOTNOTES

1. Li Jiaxhi [2621 1367 3112], He Paoyuan [6378 5508 3239], and Zhao Biru [6392 3880 1172], "The Order of Reactions of Establishing Motor Movements," JOURNAL OF PSYCHOLOGY, No 1, 1956.

2. Li Jiazhi and Xu Liancang [1776 5114 0221], "Preliminary Analysis of Industrial Accidents," JOURNAL OF PSYCHOLOGY, No 2, 1957.

3. Industrial Psychology Group of the Psychology Institute of the Chinese Academy of Sciences. "Preliminary Research in Improving the Method of Punching Operations," JOURNAL OF PSYCHOLOGY, No 1, 1959.

[Remainder of Footnotes not included]

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REVIEW OF EXPERIMENTAL PSYCHOLOGY SINCE LIBERATION

Kuda XINLI XUEBAO [ACTA PSYCHOLOGICA SINICA: JOURNAL OF PSYCHOLOGY]
in Chinese No 1, Feb 80 pp 9-14

[Article by Lin Zhongxian [2651 0112 6343] and Fang Zhi [2455 5267] of the Psychology Institute of the Chinese Academy of Sciences: "Thirty Years of Experimental Psychology in China"]

1

[Text] Experimental psychology has a long history. It was established during the middle of the last century. Methods of natural science were used to study psychological problems. This exerted an important influence in establishing psychology as an independent branch of science. But psychology was introduced into China only at the end of the Manchu Dynasty. The earliest psychology laboratory was set up by the Department of Philosophy of the University of Beijing in 1917. In old China before liberation, seven or eight schools of higher learning had already set up psychology departments. Classes included general psychology and experimental psychology; laboratories for the study of psychology had been set up, but not much actual work was done in the study of experimental psychology. At the time, research in psychological processes involved inly questions concerning learning and memory.[1]

In 1949, the People's Republic of China was founded. Under the party's leadership, the psychology departments at schools of higher learning were correspondingly reorganized and a psychological research laboratory was established at the Chinese Academy of Sciences. The broad masses of psychological workers underwent ideological reformation and conscientiously studied Marxism-Leninism. Dialectic materialism's theory of knowledge was used to guide research in psychology and the teaching of psychology. The mistaken views in the theories of experimental psychology of foreign countries were criticized.[2,3,4]

The early history of experimental psychology indicated that it was established on the beginnings of experimental research into the senses and consciousness. During the last 100 years, research in the senses and consciousness has always been the realm in which most of the research in experimental psychology has been done and the achievements have been outstanding. The Psychology

Institute of the Chinese Academy of Sciences began in 1951 to conduct preliminary research in motor senses. Work in this regard was influenced mainly by traditional experimental psychology. The content and methodology of research were not too different from those of traditional experimental psychology in Western Europe. At this time, some psychological workers of our nation began preliminary studies in the establishment of motor patterns and formation of motor skills based on Pavlov's theory of learning. Between 1951 and 1957, some experimental research was done. Some of the research followed the influence of the traditional experimental psychology of the West, while other research followed the influence of Soviet psychology.

Psychological workers in China right after the founding of the nation to answer this question: How should new China's psychology be established and where should new China's psychology go? At the time, it was proposed to follow the guidance of Marxism and to establish the new psychology on the foundation of Pavlov's theory. However, this is a process which requires time for searching in the dark. China's psychology has endured for 30 years since the founding of the nation and has traveled long and winding roads. Both in retrospect and in looking ahead, [we see that] a new era is about to arrive. Today we should make a comprehensive summary.

II

We can divide the past 30 years of our nation's experimental psychology into the following periods of development:

The period from 1951 to 1957 was the first stage of development of China's experimental psychology after the founding of the nation. Based on learning and reforms, the Psychology Institute of the Chinese Academy of Sciences during this period conducted rather systematic experimental research in motor senses. Research began in paramotor phenomena and advanced to the research of the threshold limits of motor senses and the question of the judgment of speed. In one research project of the threshold limits of motor senses conducted by Jing Qicheng [5427 0366 6134] et al,[5] a lower threshold limit of 0.66 millimeters/second and an upper threshold limit of 605.2 millimeters/second were established. In another experiment, Cao Richang [2580 2480 2490] et al,[6] studied the effect of different conditions on forecasting the course of motion. The results of research into these aspects have provided definite information about motor senses. Research in the threshold limits of motor senses received the attention of some foreign researchers. In addition, some pshychological workers also conducted experimental research in the establishment of motor patterns,[7] and through work in this field the developmental course of acquiring motor skills was studied in depth and preliminary information was compiled.

The work mentioned above all belonged to experimental research in basic theory. As our nation's socialist construction developed, the question of how our nation's experimental research in psychology could better suit the needs of our nation's development had already become an actual problem facing our nation's psychological workers. In 1957, our nation underwent

a national rectification movement. During the latter period of the movement, our nation's psychological workers exposed and criticized the tendency of separation of psychology teaching and research from reality after liberation. A debate began among psychological workers concerning the question of whether psychology should strengthen its links with actual problems. This debate should be said to have been beneficial. It made psychological workers fully realize the necessity of linking scientific research with reality. But at the same time, recognition of the importance and significance of basic theoritical research in the laboratory was insufficient. Under the circumstances at that time, emphasis on linking psychological research work of the future with reality became the major direction, and until 1961 some basic work in experimental psychology turned toward efforts to establish links with reality. During this period, experimental research work concerned with the basic theory mentioned above basically ceased.

Therefore, from 1957 to 1961, work in experimental psychology in China was mostly within the realm of industrial psychology. This can be said to be the second stage of development of our nation's experimental psychology. During this period, the Psychology Institute of the Chinese Academy of Sciences conducted research in the visual judgment of steelworkers working near flame, research in creative thought in technological renovation, and research in psychological selection of airplane pilots. Research in these respects has all been regarded highly and welcomed by concerned departments, and definte results have been obtained.

During this period, basic theoretical research in the laboratory was scattered. Some psychological workers conducted observational experiments in visual illusions[8] and stimuli from different positions.[9]

Although such work was done in laboratory conditions, the researchers linked their work to actual questions concerned with aerial observation and illusions. A more typical kind of basic theoritical research was done by Long Shuxiu [7893 0647 0208] et al.[10, 11] They determined the Chinese people's threshold limits in hearing pure tones, and drew the first hearing ability zero-level curve for Chinese. The curve approximates that published by the American Standards Association (ASA) in 1951; the number of people surveyed, the methodology, and the results were also similar. The result of this work has practical significance in the design of both communications equipment and some medical equipment and has applications in clinical otology.

In retrospect, how should we view the debate in 1958 regarding linking psychology with actual situations? It should be emphasized that the direction of linking psychology with reality cannot be said to be incorrect. The problem is not whether psychology should or should not be linked to reality, but how basic theoretical research in psychology should be viewed. This is a problem that exists in common with other sciences. There is no doubt that scientific research must be linked to reality. But can basic theoretical research conducted in laboratories all be labeled as removed from reality? The lesson of experience during this stage was exactly that. We know that exploration of some basic theoretical work is frequently a

prediction of future things. It must therefore progress further than the actual realities of life. Without basic theoretical research, it is very difficult to elevate the level of science and make science develop more rapidly. From the point of view of our nation's development of experimental psychology, some serious problems have been exposed because basic theoretical research in the laboratory was weak or even ceased. If the theoretical level does not rise, there will be a lack of systematic order. Continuing this way will be detrimental to the development of science. Our nation's psychological workers have all experienced a period of searching in the dark and have profoundly realized the necessity and importance of conducting basic theoretical research in the laboratory. Thus our nation's experimental psychology entered its third stage of development, the period between 1962 and 1966.

The period between 1962 and 1966 was one in which our nation's experimental psychology enjoyed greater progress. More systematic research was done by psychological workers of schools of higher learning and the Psychology Institute of the Chinese Academy of Sciences in such aspects as senses and consciousness, memory, and thought. The Psychology Institute of the Chinese Academy of Sciences expanded its laboratory and strengthened basic theoretical research in experimental psychology during this period. And starting in 1962, a series of scientific papers of definite value was published.

In this period, the major subject of study was spatial consciousness, such as consciousness of distances,[12-19] depth,[20-21] consciousness, and visual determination of direction and position.[22-23] The work in these fields systematically explored the effects of various factors that affect the consciousness of distances and the visual determination of positions. A series of basic data of value was obtained. Some research results in these aspects have been used by relevant departments. Jing Qicheng [5427 0366 6234] et al, proposed a theory on the relationship between the self and the surrounding environment based on a series of research results. It was believed that constancy of consciousness is formed and developed by the mutual relationship between man's social practices and his surrounding environment. In spatial consciousness, the normal relationship between man's own position and his surrounding environment is an important condition of constancy of consciousness. When the normal relationship between people and their environment is destroyed, constancy of consciousness will be destroyed to different degrees. The series of work in these aspects of research, compared to topics being studied in foreign nations at the time, was unique to our nation. A lot of experimental work described above was conducted in actual situations under natural conditions and approached actual happenings. Scholars of some foreign nations believed that the work of our nation's psychologists of the time grasped the mainstream of international research in consciousness.

In addition, preliminary exploratory research in the consciousness of pictures was also launched. Peng Ruixiang [1756 3843 4382] et al,[24,25] explored the characteristics of picture recognition and factors affecting repeated recognition of pictures, and some preliminary results were obtained.

hearing consciousness research also developed rather rapidly during this period. Ma Dayou [7456 1129 3731] et al,[26] conducted a great deal of research in the statistics of sound of ordinary speech, compilation of testing materials, methods of testing, and methods of prediction of clarity, and a definite amount of basic data was obtained. In language consciousness, Liang Zhian [2733 0037 1344],[27] and Fang Zhi [2455 5267][28] separately studied the important functions of acoustical characteristics of sounds of ordinary speech, rhyme and accent in consciousness. Fang Zhi proposed a three-level view by considering the effect of transmission of language and by considering the decoding mechanism of consciousness. Some work in this aspect possesses definite value.

During this period, research was also done in the mutual action of different sensory channels of the sense of touch and the sense of movement.[29-32] In addition, a lot of research work was related to the study of the formulation of repeated illusions.[33-36] A few studies were done on Mueller-Leier illusion,[37] and some discussions on the general theory of illusions were published.[38] Some preliminary results were obtained in research work in all areas.

Some rather complex psychological phenomena, such as the question concerning the linking of colors and forms, were preliminarily explored in research conducted by Chen Li [7115 4539] et al.[39] The work had real significance in the development of the study of children's abilities in abstraction and generalization, but it was attacked and denounced in the paper by articles written by one of the members of the "gang of four," Yao Wenyuan (pseudonym Ge Minjen [5514 6900 0086], as being "metaphysical," "idealistic," and "counterscientific." Chen Li et al wrote articles in retort. This was the so-called "Ge Chen debate" in the realm of psychology that caused a sensation on the eve of the Great Cultural Revolution.

What are the experiences during this stage that can be summarized?

During the period 1962 and 1966, experimental psychology developed rather quickly in our nation because of the emphasis on basic experimental research in psychology. If we consider that during the period from 1951 to 1957, the scope of research in experimental psychology was narrow, covering only research in motor senses, then during this period (1962-1966), experimental psychology was engaged in many research subjects, such as distance sensing, sensing changes in depth, spatial determination of position, sensing of pictures, hearing, touch, sensing of movement, mutual effects of senses and illusions. Definite achievements and results were obtained during this period such as the relatively great progress in spatial consciousness and hearing consciousness, among other good results.

This fact illustrates the principle that emphasis on basic experimental research and scientific research must have relative stability and systematic order. These in turn will aid a more rapid raising of the level of scientific theory and quicker achievements. If our nation's psychological workers can persist in this direction, then our nation's experimental psychology

today will develop even faster and achieve richer results. But it was a pity that from 1966 on, experimental psychology, which was on the road toward prosperous growth, was trampled upon and abused by the dark hands of the "gang of four" that extended into the circles of psychology. They coldbloodedly tore apart the experimental methods of psychology and launched a massive campaign of accusation and denunciation and accused psychology as being "capitalist class psychology." Many psychologists were persecuted. Research and teaching of psychology were forced to cease for a very long period. The development of psychology suffered a serious loss.

In the "Ge Chen debate," our nation's many psychological workers opposed the nonsense expressed by Yao Wenyuan, who knew nothing about psychology, who did not have an understanding of even the most basic knowledge of scientific experimentation and who was a charlatan. But under the circumstances of the time, any sentence in disagreement would be labeled a "vicious attack" by the "capitalist class," and the person would be criticized. Academic questions became confused with political questions. Political criticism replaced academic discussion. Organized encirclement was used as a method to suppress differing opinions. There was a lack of academic democracy. This could only hinder scientific research, suffocate academic thought, and destroy scientific research teams. The lesson of this experience is very painful, and it should not happen again in the future.

Although psychology was abused by the "gang of four," some psychological workers still persisted under very difficult conditions in conducting scientific experimental research. In 1972, scientific researchers of the Psychology Institute of the Chinese Academy of Sciences began to engage in research in experimental psychology. In 1976, after the Party Central Committee headed by Chairman Hua launched the strike to crush the "gang of four," psychology received a new life and was again able to see daylight and its reputation was revivied. The broad masses of psychological workers all were happy. In recent years, especially after crushing the "gang of four," our nation's experimental psychology has developed relatively rapidly. In only a few years, many valuable achievements have been made. It can be said that after 1976, when the "gang of four" was defeated, the fourth stage in the development of our nation's experimental psychology began.

During this period, some psychological research organizations were revived and rebuilt. Teaching activities and psychology research laboratories were reopened at some schools of higher learning. As the great situation in our nation developed, several colleges and schools of higher learning have expanded and established departments of psychology and have begun to admit undergraduates and graduate students. In May of this year, the Psychology Institute of the Chinese Academy of Sciences and the Hangzhou University jointly established a study class for experimental psychology teachers at schools of higher learning, and a group of experimental psychology teachers has been trained. An experimental psychology staff committee will be set up at this year's annual conference of the third academic conference of the Chinese Psychology Society. All of this signifies that our nation's research in and teaching of experimental psychology have advanced beyond a new height in development.

In research work, the Psychology Institute of the Chinese Academy of Sciences has launched systematic research into color vision. He Baoyuan [6378 5508 3293] et al,[40] have shown, through the results of research into relative visual functions of the light spectrum of the eye of the Chinese that there is no obvious difference between the curve corresponding to CIE and the relative visual brightness curve of the light spectrum of Chinese people's eyes. This proves that ethnological differences have no important influence upon visual brightness of the light spectrum. It was further discovered that age, field of vision, and level of brightness exert a definite effect upon the function V (λ). Yang Xiongli [2799 7160 6849] et al,[41] of the Psychology Institute of the Chinese Academy of Sciences, also conducted research on related questions. Achievements in this aspect have a definite value in photometry and colorimetry.

Lin Zhongxian [2651 0112 6343] and Peng Ruixiang et al,[42-47] conducted systematic studies of the colorimetric characteristics of the skin color of the Chinese and the color tolerance of the memory, and they obtained a series of basic data which fill in some of the voids in these areas in our nation. This work was comparable to the same kind of work being done abroad in the number of people surveyed, the methodology of testing, and the experimental techniques. Research results in these areas have already been applied in the standardization of color electrochromatic cards, evaluation of color development of light source, and standardization of colors.

Jing Qicheng et al,[48,49] designed a double integration spherical viewing colorimeter. This instrument not only can produce comparative colors but also can produce colors to be tested. This instrument was used to conduct coupling experiments of colors of four types of illuminating bodies designated A, D_{55}, D_{65}, and D_{75}, and the tolerance of coupling of colors of the four kinds of illuminating bodies was obtained. This work has actual significance in the colorimetric coupling of various standard light sources.

In addition, Yu Jisheng [5713 4480 3932] et al,[50-52] measured some basic parameters of depth consciousness and obtained meaningful basic data. Zhang Houcan [1728 0624 4732] et al,[53] explored the relationship between subjective profiles and depth clues. Wang Su [3769 3936][54] conducted research in the relationship between methods of touching and consciousness of the duration of the sense of touch; some preliminary results have been obtained.

The Psychology Institute of the Chinese Academy of Sciences also conducted research in hearing. Fang Zhi and Shen Hua [3088 8518] et al,[55] studied estimates of hearing ability of ordinary speech and preliminarily determined the quantitative relationship between the hearing ability of pure sounds and the hearing ability of ordinary speech. They showed that the three-frequency estimation formula established by AAOO of the United States is also applicable to ordinary Chinese speech. But Wang Naiyi [3679 0035 1837] et al,[56] concluded that the threshold value of damage of ordinary speech is lower. Zhang Jialu [1728 1367 7498],[57] of the Acoustics Institute of

the Chinese Academy of Sciences, believed that "consciousness of language is first a sensory process, and it should not be overly emphasized as a motor function, as in the theory of motor senses." He proposed the theory of reflective consciousness of language based on his experimental research and understanding of the process of consciousness of language. This theory disagrees with some of the viewpoints in foreign nations concerning the theory of language consciousness. Work in this aspect has established a foundation for further in-depth research.

In summary, it can be seen that research in experimental psychology during this period again developed, and within a very few years welcoming achievements have been made one after another in some realms such as color vision, depth consciousness, and hearing. These achievements have been established as national standards. This shows that under the guidance of the correct line, experimental psychology has been able to develop its important function more and more in socialist construction.

III

Although during the past 30 years the development of psychology in China has traveled a path of hardships and has suffered bitter experiences, many psychological workers in the past 30 years have overcome various difficulties, under the guidance of the correct line of the party, and have persisted in conducting experimental research in psychology. In some realms they have accumulated such valuable scientific data, produced definite achievements, and published a series of papers with a definite scientific caliber.

In retrospect, it is necessary to summarize the lessons of experience well. But it is more important to broaden our views and look into the future to see the bright future of the development of experimental psychology in China and the tasks of our nation's psychological workers. Here we will discuss some viewpoints.

1. First, we should realize that the present state of China's experimental psychology is still backward and that it cannot suit the needs of present development in our nation very well. There is still a relatively big distance between our progress and the advanced levels of international achievements in psychology. We should pay attention to learning and absorbing the advanced things of foreign nations and strengthen academic exchange activities with foreign nations. We must have the courage to surpass the advanced international levels. We must not simply be satisfied with representing the work of foreign researchers. We should possess our own national characteristics in research and make discoveries, invent, and create. We should use the viewpoint of dialectical materialism to guide our research. As we absorb the cumulative achievements of psychology from the past and the present, we must establish a theoretical system of experimental psychology in our nation and strive toward the realization, within not too long a time, of first-rate scientific research achievements that possess our nation's characteristics in some realms.

2. Experimental psychology should take in useful achievements of similar sciences, especially new techniques, new concepts, and new methods. Experimental psychology emphasizes experiments. It uses mainly experimental methods to explore man's psychological phenomena. In recent years, as scientific technology progresses day by day, some new techniques are being developed internationally. New concepts and new methods, such as cybernetics, information theory, microelectrode techniques, molecular biology, and mathematical analysis, have been introduced into the realm of psychology. These have elevated the level of experimental research in psychology visibly. Psychologists treat sensing, learning, memory and thinking and such psychological processes from the angle of information processing. They now more than ever share a common language with similar sciences, and this is even more beneficial to the development of psychology. We should strengthen the construction of modern laboratories and use equipment and facilities of advanced technology. Only in this way can the secrets of psychological phenomena be revealed step by step.

3. Generally speaking, the scope of research over the past 30 years in experimental psychology in our nation is still very narrow. Relatively more research has been conducted only in studying the senses and consciousness. Some work which has slackened off in recent years, such as research in memory and thought, should be intensified. In addition, research in experimental psychology in our nation should be developed step by step in higher normal colleges and schools. Viewing the development of psychology in the international realm, we see that rather much progress has been made in recent years in the study of memory and learning at the molecular level and in the research of senses, consciousness, visual effects and visual perception. People have discovered that "specialized" cells exist for different sensory perceptions. Some react only to parallel lines. Some react only to perpendicular lines. Some react to definite angles and pictures. And there are even specialized perception cells that react to direction of motion, visual differentials between the eyes, color, and speech sounds. This has deepened the understanding of the process of information processing by means of visual channels at different levels. The development of each science in different stages has its own leading realm. This realm is situated in a central position and exercises a leading function. Viewing the present development of experimental psychology, it can be seen that research in consciousness and memory is in a leading position. Breakthroughs will probably come in these areas in the near future. Therefore, research in these aspects should be greatly strengthened.

4. Classification within experimental psychology is relative, not absolute. Experimental psychology is very closely related to industrial psychology and engineering psychology. Experimental psychology emphasizes basic theoretical research even more. In basic theoretical research, experimental research in laboratories is both necessary and important. But this is not the only research path. Some work requires observation and survey and must be conducted in combination with reality. We must emphasize a close combination of research and reality and carry out research work that serves the actual situation. The principles of linking theory and reality must be firmly implemented.

Experimental psychology will occupy an important position in realizing the modernization of psychology. As experimental methods and techniques develop further and approach perfect, it can be foreseen that the scientific explanation of some complicated psychological phenomena will be elevated to a new level. Whether some complicated phenomena of social psychology such as man's social emotions, attitudes, motives, wishes, and needs can be purposefully studied by conducting controlled experimental research using methods and techniques of experimental psychology is still a question for further exploration by experimental psychological workers.

FOOTNOTES

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[Remainder of Footnotes not included]

9296
CSO: 4008

'HUNAN RIBAO' COMMENTS ON PROMOTING SCIENCE, TECHNOLOGY

HK161330 Changsha Hunan Provincial Service in Mandarin 2315 GMT 14 Jul 80

[Excerpts from 14 July editorial: "It Is Imperative To Relentlessly Grasp Scientific and Technological Work"]

[Text] The editorial says: Since the national and provincial meetings on scientific and technological work, the majority of leading comrades have continuously increased their awareness of the need to grasp scientific and technological work. However, some of them still know little or nothing about the general situation in which the development of the national economy relies more and more on the development of science and technology. They still think that grasping scientific and technological work is a slow remedy which cannot meet a current urgent need. They say that scientific research is something that can be delayed. This shows that to better carry out scientific and technological work we must go further to concretely solve the question of leaders at various levels understanding scientific and technological work.

The editorial points out: In modern times, without a new breakthrough in science and technology, there cannot be a fundamental change in the methods of production or rapid development in productive forces. Competition in production is essentially competition in science and technology. Science and technology play an obvious role in promoting productive forces. They involve very arduous tasks. They are important and have to be tightly grasped without delay.

Of course, it takes time for science and technology to be transformed into productive forces. That is to say, only by being continuously and extensively applied to production will scientific and technological achievements be changed into real productive forces and quickly improve the outlook of production. The party and government leading organizations at all levels and the superstructure departments such as the economic and scientific administrative offices should make strenuous efforts to carry out organizational and leadership work in a concrete way. All departments concerned should work out and adopt practical measures in accordance with policy and the

organizational and administrative systems and take prompt action to apply the scientific and technological achievements to production. Comrades of scientific research offices should also go deep into reality to discern the conditions in industrial and agricultural production, in cultural, educational and public health work and in people's daily lives.

Proceeding from the realities of our province and from our own scientific and technological strength and level and other conditions, they should bring forth our strong points, avoid our shortcomings and bring about good economic results. In suggesting topics for scientific research, they should pay close attention to linking the long term plans of economic construction with the long term plans of science and technology. They should not treat these two plans as unrelated matters.

In conclusion, the editorial says: Achievements stem from capable people. High quality achievements stem from highly capable people. We must vigorously train, discover and promote capable people, employ capable people without sticking to hard and fast rules and really make the best possible use of men and materials. Leading party and government cadres at all levels should further emancipate their minds, completely break the fetters of such feudal ideas as giving promot'ons on order of age and seniority and suppressing and being jealous of the capable, take solid action instead of paying lip service, promote the exploitation of intellectual strength and strive to place all capable people in suitable positions. In this way, a completely new situation of prosperity in scientific and technological work will surely emerge throughout the province.

CSO: 4008

SCIENTIST VIEWS RESEARCH INTO HUMAN BODY'S EXTRAORDINARY FUNCTIONS

OW171044 Beijing XINHUA Domestic Service in Chinese 0120 GMT 12 Jul 80

[Excerpts] Beijing, 17 Jul--Noted Chinese scientist Qian Xuesen recently talked to the reporters of some newspapers in Beijing on the discovery of some Chinese children's extraordinary sensory capabilities in recent years, such as reading and identifying pictures with their ears and armpits. Qian Xuesen pointed out that the science of life is a branch of scientific research that is receiving universal attention in the world today, and comprehensive research is being conducted by many countries with large amounts of personnel and material. He added that the discovery of young people with extraordinary capabilities in China has provided research on the human body's unusual functions with a very important clue.

Qian Xuesen told the reporters: According to Marxist philosophy, knowledge is derived from objective things. As scientists, we must first observe objective realities, and we should not negate the existence of a certain phenomenon simply because we cannot provide a scientific explanation for the time being.

Answering a question on the relationship between the human body's unusual functions and the four modernizations put to him by some reporters, Qian Xuesen said: An important mission of a scientist is to unceasingly explore the mysteries of nature. There are basic sciences and technical sciences. Although some basic sciences cannot be immediately applied to production, they are still very important in view of long-range needs. Otherwise, it would no longer be necessary to study fundamental particles and build high-energy accelerators. The research on the human body's unusual functions will definitely help mankind to better understand itself and further develop the life sciences.

Qian Xuesen was delighted with the recent establishment of research groups for the human body's extraordinary capabilities by many research units, higher learning institutes and colleges throughout the country. He pointed out that instead of dramatizing things, research should be conducted with the participation of psychologists and physiologists, and that under proper conditions, scientific tests with special equipment should be conducted among young people.

Participating in this interview were reporters from RENMIN RIBAO, XINHUA News Agency, the Central People's Broadcasting Station, JIEFANGJUN BAO, BEIJING KEJI BAO and China News Agency, and comrades from the Shanghai ZIRAN ZAZHI [15261 3544 7177 1807] and the Aviation Medical Research Institute of the PLA Air Force. The interview took place on 5 July.

CSO: 4008

SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

BEIJING MUNICIPAL SCIENCE, TECHNOLOGY CONGRESS OPENS

HK270412 Beijing City Service in Mandarin 2300 GMT 16 Jun 80

[Summary] The second congress of the Beijing municipal Science and Technology Association opened on the morning of 16 June. A total of 615 representatives attended the congress. Mao Lianjue, secretary of the Beijing municipal CCP Committee; Bai Jiefu, Standing Committee member of the municipal CCP Committee and vice mayor; (Pei Lisheng), vice chairman of the Chinese Science Association; and Mao Yisheng, chairman of the municipal Science and Technology Association, attended the opening ceremony. (Tian Fu), secretary of the party organization of the municipal Science and Technology Association, presided over the congress and (Wang Shuzhuang), vice chairman of the municipal Science and Technology Association, delivered the opening speech.

He said: "This congress will emphatically revolve around the four proposals of the Central Secretariat on the work principles for Beijing and mobilize the science and technology workers in the capital to propose plans and policy and make contributions."

Mao Yisheng made a work report on building a modern capital with high level of science and technology. He pointed out: "A high level of science and culture and important spiritual and material pillars for lofty social virtues and style; they are the key for building a clean, beautiful and convenient city and a prosperous economy. To implement the four proposals of the Central Secretariat and build a modern capital, the principle tasks of the municipal Science and Technology Association for the future are:

"First, we must closely coordinate these tasks with the needs of the four modernizations, and extensively and thoroughly launch academic activities. Beijing should be the center for academic study exchanges.

"Second, we must effectively do a good job of popularizing science and technology and enhance the scientific and cultural level of the people in the capital. Third, we must propose plans and policy for building the capital and be good staff officers and advisers to the party and government. Third, we must propose plans and policy for building the capital and be

good staff officers and advisers to the party and government. Fourth, we must actively discover and cultivate capable people and develop the ranks of science and technology in the capital. Fifth, we must effectively launch international academic study exchanges."

Responsible comrades of the Beijing Federation of Trade Unions, the Beijing CYL Committee, the Beijing Women's Federation and the Beijing Federation of Culture, extended their congratulations at the opening ceremony.

CSO: 4008

SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

'XINHUA RIBAO' CALLS FOR TRAINING TALENTED PERSONS

OW271153 Nanjing Jiangsu Provincial Service in Mandarin 2300 GMT 26 Jun 80

[Report on XINHUA RIBAO editorial: "Pay Attention To Training Talented People To Speed Up the Development of Science and Technology"--date not given]

[Excerpts] The editorial says: Science and technology are productive forces, and the modernization of science and technology is the linchpin on which the realization of the four modernizations depends. To speed up the development of science and technology, we must pay attention to and effectively strengthen the training of scientific and technical personnel and bring their role into full play. If the question of discovering talented people is not solved and if we fail to develop science and technology, the four modernizations will become empty talk. Judging from the conditions of Jiangsu's scientific and technological ranks, they still cannot meet the needs of the construction for the four modernizations in terms of quantity nor of quality. Therefore, while accelerating the development of education and the training of personnel of various specialized fields, we must particularly value our existing scientific and technical personnel, tap their potential and fully utilize their roles.

The editorial says: In order to tap the potential of talented people and to enable each talented person to develop his talent to the fullest and to have a role to play, we must take into account the overall interest of the four modernizations, eliminate prejudices and select talented people indiscriminately. We should boldly select and rationally use well-trained scientific and technical personnel irrespective of experience and age. Some unreasonable regulations governing the employment of personnel should be reformed, if necessary, on the basis of investigation and study. Scientific researchers who study very hard should be encouraged to establish their reputation as authorities and to make greater contributions to China's four modernizations. Never again should we use such spiritual shackles as "thought of fame and gains" and "taking the road of white specialists" to fetter them.

To give full play to the role of people with specialized knowledge, we must enable scientific and technical personnel to apply what they have learned and assign them appropriate jobs. Besides, we must create working conditions for them and help them to further their studies and overcome difficulties in their work and daily life in order to enable them to devote themselves to their [illegible]

CSO: 4008

BRIEFS

SCIENTIST STILL MISSING--Urumqi, 16 Jul--Noted scientist Peng Jiamu has been missing for 30 days now and ground and air search has still failed to locate him, according to a report by XINHUA correspondents Song Zhenghou and Zhao Quanzhang. The east route searching team has been withdrawn, but the west route searching team is making a last minute effort in the hope of locating him. The Lop Nur depression has rolling sandy hills and ravines, a hard salty surface and a vast expanse of desert known as the Gobi extending to the horizon. Members of the east and west route searching teams braved the scorching heat of about 50 degrees C to scan the blistering desert. They pressed forward during the day and stopped for rest after sunset. Sometimes they traveled by car; at other times they walked. They made sweeping searches in some localities. In areas where sandy hills stand like forests, it was difficult to maintain contact between two cars or two individual members of the searching teams if they were separated by 100 meters. Visibility in the clusters of weeds was as low as 20 to 30 meters. Vehicles and members of the searching teams can easily lose their orientation. The searching operation has met many difficulties. Clues found were lost due to the vast expanse and complex terrain in the desert area and it was extremely difficult to find any trace of the missing Peng Jiamu. The air force has flown missions up to more than 100 hours and has not yet discovered anything about the missing scientist. [Text] [OW162130 Geijing XINHUA Domestic Service in Chinese 1321 GMT 16 Jul 80]

SHANGHAI SCIENTIFIC, TECHNOLOGICAL ASSOCIATION--Elected by the (5th) congress of the Shanghai municipal Scientific and Technological Association, the 210-member committee of the association held a plenary session on 27 May where Li Guohao was elected chairman and Jiazhen, Shi Meixin, Feng Depei and others were elected vice chairmen. A 35-member Standing Committee was also elected. Famous scientists Su Buqing and Zhao Zukang were named advisers to the municipal Scientific and Technological Association. [Shanghai City Service in Mandarin 2300 GMT 29 May 80]

CSO: 4008

LRC-201 SELF-TUNING REGULATOR FOR THE LEVEL OF ACETIC ACID DISTILLATOR

Beijing ZIDONGHUA XUEBAO [ACTA AUTOMATICA SINICA] in Chinese Vol 6 No 2, Apr 80 p 93

Ying Shuguang [2019 2579 0342] Beijing Organic Chemical Plant

[Abstract] This paper introduces the application of self-tuning regulator to the level control of acetic acid distillator. The self-tuning regulator is able to compensate for the time delay and disturbances to a certain extent that the anti-interference effect of the system is enhanced and the regulating quality of the system is improved. Since the on-line calculating work is not so much and the implementation is relatively simple, therefore it is a promising regulator.

THE LIMITATION OF SAMPLING FREQUENCY FROM SYSTEM ERROR IN HYBRID SIMULATION

Beijing ZIDONGHUA XUEBAO [ACTA AUTOMATICA SINICA] in Chinese Vol 6 No 2, Apr 80 p 102

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[Abstract] A mini-hybrid computer system HAP-2/DJS-130 is introduced and the limitation of sampling frequency from system error is discussed in this paper. This result is very useful for hybrid simulation design.

A CAR SPEED CONTROL SYSTEM OF THE AUTOMATIC MARSHALLING YARD SYSTEM

Beijing ZIDONGHUA XUEBAO [ACTA AUTOMATICA SINICA] in Chinese Vol 6 No 2, Apr 80 p 111

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[Abstract] A car speed control system of the automatic marshalling yard is described in this paper. The authors propose to search the varying laws of the rolling resistance in front and behind of the retarder by means of method of mathematical statistics as well as to estimate the rolling resistance of cars on marshalling track by the equation of linear regression.

A trial run for the control system has been carried out at the Fenxi marshalling yard near Beijing and desired results have been achieved. Practice shows that it is a simple, economical, safe and reliable automatic control system.

A DIGITAL-ANALOG HYBRID SYSTEM AND ITS APPLICATION TO THE AUTOMATIC FLIGHT CONTROL SYSTEM SIMULATION RESEARCH

Beijing ZIDONGHUA XUEBAO [ACTA AUTOMATICA SINICA] in Chinese Vol 6 No 2, Apr 80 p 120

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[Abstract] Specifications of a digital-analog hybrid system which consists of DJS-8 digital computer and HMJ-200 analog computer and its application to the simulation research for automatic flight control system are introduced in this paper. A hybrid computing example is given to illustrate its application.

ON THE QUANTITATIVE AND QUALITATIVE DIFFERENTIAL GAMES

Beijing ZIDONGHUA XUEBAO [ACTA AUTOMATICA SINICA] in Chinese Vol 6 No 2, Apr 80 p 130

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[Abstract] In this paper, by developing the method in [2, 3, 4, 5, 7], we solve the problems of quantitative and qualitative differential games. For the former, we derive the necessary condition for optimal strategy $(\bar{u},\bar{v})$, i.e., the "minimax principle." For the latter, we also obtain the necessary condition of the optimality of $(\bar{u}, \bar{v})$, and thereby determine the differential equations of the "barrier." Here we need not limit our analysis "in the small" as in [1].

We discuss also other problems, such as sufficient condition, the more general terminal set, and the relation between qualitative differential games and controllability problems.

Therefore, the method that we used is a powerful one to solve various problems of optimal control as well as differential games.

Two examples are given.

RELATIONS BETWEEN THE SYSTEM INVARIANTS VS SYSTEM STRUCTURE AND PARAMETERS

Beijing ZIDONGHUA XUEBAO [ACTA AUTOMATICA SINICA] in Chinese Vol 6 No 2, Apr 80 p 137

Guo Rongjiang [6753 2837 3068], Institute of Automation, Academia Sinica

[Abstract] This paper discusses the relations between system invariants (including Kronecker index etc.) and system structure and parameters. The physical meaning of those invariants are also discussed.

SOME PROBLEMS IN MODERN CONTROL THEORY

Beijing ZIDONGHUA XUEBAO [ACTA AUTOMATICA SINICA] in Chinese Vol 6 No 2, Apr 80 p 145

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[Abstract] We give here a brief survey on the recent development of modern control theory. In particular we give a review of the results recently obtained in both theory and applications by authors of our country in the following directions: theory of linear control systems, theory and applications of optimal control, control systems containing typical nonlinearities, digital control system with quantized inputs and quantized outputs, stochastic control, control and identification of systems with distributed parameters, differential games, system identification, adaptive control and so on. The author expresses his personal opinion and from the needs of engineering practice as well as from theoretical development he proposed several problems that may be of interest for further research in the different directions mentioned above.

REAL-TIME DIGITAL SIMULATION METHODS

Beijing ZIDONGHUA XUEBAO [ACTA AUTOMATICA SINICA] in Chinese Vol 6 No 2, Apr 80 p 154

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[Abstract] This paper introduces some fast and stable digital simulation methods which can be used in real-time control or real-time simulation.

CSO: 4009

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TITLE: "Transposition of Antibiotic Resistance Genes between Bacterial Plasmids"*

SOURCE: Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese No 3, Sep 79 pp 239-246

TEXT OF ENGLISH ABSTRACT: Escherichia coli strains 275 and 396 are resistant to antibiotics Tc, Ap, Cm, Sm and Su. Shigella flexneri strains 233 and 416 are resistant to Tc, Cm, Sm and Su. Except for E. coli 275, these strains transferred their resistance to recipient strains as one unit at a frequency of about 10^{-5}-10^{-7} even when selected for either one of the drugs. It seems that the

[Continuation of YICHUAN XUEBAO No 3, Sep 79 pp 239-246]

genes governing these resistances were located on plasmids. We designated these plasmids as ER275 (nonconjugative), ER396, DR233 and DR416 respectively. When the above bacterial strains were mated with E. coli strain J5-3/R144drd3 (Km^r), strains with two coexisting plasmids were constructed. We used these strains with two coexisting plasmids as donor strains, and selected for Ap or Sm resistance to obtain ApKm or SmSuKm resistant transconjugant. These transconjugants transferred their resistance to recipient strains as one unit at a frequency of about 10^{-4}-10^{-2}, which was also the frequencies for R144drd3 plasmid.

Biochemical studies have shown that the Ap resistant gene of ER275 and ER396 mediated the formation of β-lactamase, and the Sm resistant gene of DR233 and DR416, the formation of the ATP-dependent streptomycin inactivating enzyme. The ApKm and SmSuKm transconjugants acquired the ability to synthesize the two kinds of enzyme.

According to these results, it is suggested that on the ER275 and ER396 as well as DR233 and DR416 plasmids transposable Ap resistant gene and transposable SmSu genes existed respectively.

[Continuation of YICHUAN XUEBAO No 3, Sep 79 pp 239-246]

* Professors SHEN Shanjiong [3088 0810 3518] and JIAO Ruisheng [3542 3843 6500] revised the draft.
Received 5 December 1978.

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TITLE: "Hybridization and Selection of Yeasts. III. Identification and Characterization of New Maltose Complementary Genes in Saccharomyces"*

SOURCE: Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese No 3, Sep 79 pp 247-254

EXCERPT FROM ENGLISH ABSTRACT: Hybridization of different natural yeasts, i.e. Saccharomyces microellipsoides (2.699-2-3), Saccharomyces globosus (2.1161-6, 2.1153), Saccharomyces chevalieri (2.213-4C) and Saccharomyces exiguus (2.520), were obtained by means of micromanipulation. The tetrad analysis of some hybrids led to the discovery of two complementary genes systems. The two systems had been identified as intergenic complementary entities. One of them was proved to carry a complementary gene, MAL_{m-1}, and a nonallelic complementary gene, MAL_{g-1}, while the other carried one of the complementary genes in the former system, i.e. MAL_{m-1}, and another gene MAL_{g-2}, which was also one of the complementary genes for maltose fermentation but nonallelic with MAL_{g-1}.

[Continuation of YICHUAN XUEBAO No 3, Sep 79 pp 247-254]

Identification of maltose complementary genes was performed by tetrad analysis. Three maltose complementary genes were isolated from Saccharomyces. One of them, MAL_{g-1} in Sacch. microellipsoides, was first proved in this paper. The other genes, MAL_{g-1} and MAL_{g-2}, were derived from Sacch. globosus. Gene MAL_{g-1} plays an indispensable role in all cross combinations.

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TITLE: "Some Features of Conjugative Transfer of the Drug Resistant Plasmid pFD11 in Escherichia coli"*

SOURCE: Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese No 3, Sep 79 pp 255-260

TEXT OF ENGLISH ABSTRACT: Once the pFD11 plasmid was transferred to E. coli strain C_{600} either through transformation or transduction, it was unable to ensure its own transmission by conjugation.

The plasmid DNA isolated from transformant C_{600} (pFD11) retained only the band with presumably highest molecular weight inferred from agarose gel electrophoresis. It is therefore concluded that it is the band of the resistance determining factor.

* Received 19 March 1979.

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TITLE: "In Vitro Construction of a Recombinant Plasmid Containing pBR322 and Lambda Phage DNA Segment"*

SOURCE: Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese No 3, Sep 79 pp 261-267

TEXT OF ENGLISH ABSTRACT: Hind III cleavage products off DNA were ligated to a vector plasmid pBR322. Recombinants Ap^rTc^s were screened by insertion inactivation and were enriched by DL-cycloserine. Of 648 Ap^r transformants examined, 120 contained insertion of λ-Hind III fragments. Clone containing recombinant plasmid pAG-5 was chosen for further study. Evidence for presence of λ DNA in pAG-5 plasmid was obtained by isolating the recombinant plasmid DNA from it, and analyzing this DNA on agarose gels. Recombinant plasmid pAG-5 has a slower

[Continuation of YICHUAN XUEBAO No 3, Sep 79 pp 261-267]

mobility, indicating it was larger in size than the original pBR322 plasmid. This was also confirmed by electron micrography. Agarose gel electrophoresis of Hind III digests of pAG-5 recombinant plasmid gave rise to two fragments corresponding to pBR322 DNA and the fifth fragment of Hind III generated λ DNA. About 4.0 - 4.6 x 10^3 transformants were obtained per μg recombinant plasmid pAG-5 DNA.

* Received 2 April 1979.

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ORG: Shanghai Cooperation Team on Leukocyte Typing

TITLE: "Study of the Chinese Leukocyte Antigen System. III. The Genetic Analysis of 11 Leukocyte Antigens"*

SOURCE: Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese No 3, Sep 79 pp 268-276

EXCERPT FROM ENGLISH ABSTRACT: Human leukocyte antigen system (HLA), which has much to do with the clinical transplantation, is a highly polymorphic system genetically controlled by a segment of the short arm of the sixth chromosome. The classical HLA-A, B, C antigens have been defined serologically. In this paper the authors report the genetic analysis of 11 leukocyte antigen specificities which were detected with the typing reagents from the multiparous women of the same population as the random lymphocyte donors tested. Ninety-nine blood donors and 69 other voluntary individuals taken from inhabitants of the Han nationality in Shanghai area were included in the random sample for population genetic analysis. Family material included 24 families with a total of 67 children. Lymphocyte suspensions were tested with a modified two-step microlymphocytotoxicity technique of Terasaki and McClelland (1964).

* Received 5 February 1979.

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TITLE: "Genetic Etiology of Esophageal Cancer. I. Cytogenetic Study of Individuals in Five 'Cancer Families' in Linxian County"*

SOURCE: Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese No 3, Sep 79 pp 277-284

TEXT OF ENGLISH ABSTRACT: Studies on 5,500 metaphase plates from 103 members of 5 high risk cancer families and 1,567 metaphase plates from 30 members of 4 low risk cancer families were carried out. The investigated individuals of both groups lived in close proximity. Although the modal number and Karyotype were normal diploid ($2n = 46$), many more cells from members of high risk cancer families were found to show aneuploid and various types of structural aberrations than those from members of low risk families. In the high risk group, 1.6 percent of the cells showed numerical aberrations and 3.25 percent structural aberrations, while the corresponding figures for the low risk group were 0.5 percent and 0.72 percent respectively ($p < 0.01$). The 101 chromatid breaks found in the high risk cancer families were mostly distributed among chromosomes

[Continuation of YICHUAN XUEBAO No 3, Sep 79 pp 277-284]

of A, B and C groups and occurred more frequently in long arms (q) than in short arms (p). During karyotyping it was found that chromosomes A2 could not be matched with each other in 10 cells out of 300. The interaction between genetic and environmental factors in the carcinogenesis of esophageal cancer in Linxian County was briefly discussed.

*Colleague ZHANG Xueyan [1728 7185 5333] took part in some of the work. YU Hongyi [0060 3163 5030] and FU Guangxing [0102 1684 5281], barefoot doctors of Yaolin Commune, Linxian County, assisted in the investigation of family trees. Received 9 September 1978.

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TITLE: "Genetic and Etiologic Studies on Mental Defectives in the Region of Daibie Mountain"*

SOURCE: Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese No 3, Sep 79 pp 285-292

TEXT OF ENGLISH ABSTRACT: The present paper describes mental defectives prevalent in the region of Daibie Mountain. The persons with mental defects are characterized primarily by low intellectual capacity. It seems clear that the causes of mental retardation are rather complex and could be influenced by both genetic factors and environmental conditions.

In the last few years, we carried out a general survey and a series of laboratory works, including electrocardiographic and electroencephalographic analysis, radiograph of skull, thyroid uptake of ^{131}I, potassium perchloride test, thyroid stimulating hormone (TSH) test, assay of protein bound iodine in serum, resin (^{125}I-T_3) uptake test, blood grouping as well as chromosomal analysis of

[Continuation of YICHUAN XUEBAO No 3, Sep 79 pp 285-292]

peripheral blood.

Based on the results obtained, we discuss the relationships between the causes of mental defects and iodine deficiency in the mountain region, and emphasize especially the genetic aspects of the disease. It is noticed that among the endemic mental defectives, quite a number of them are familial. Hence, we favor the opinion that the defects may be due to both genetic predisposition and iodine deficiency in diet.

The studies are still going on and the results obtained from now on will be reported subsequently.

* The writers were YE Wenhu [5509 2429 5706], TAN Yongbu [6151 3196 1580], HOU Yongjian [0186 3057 0256], MA Jixiao [7456 1376 2556] and LIU Zudong [0491 4371 3159]. The Institute of Physiological Research and the Institute of Bio-Chemical Products, Shanghai, Teacher's College of Shanghai, as well as the Station of Sanitation and Epidemic Prevention of Yuexi, Anhui, took part in the work.
Received 18 July 1978.

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TITLE: "Analysis of G- and C-Banding Patterns and Finding of Two Marker Chromosomes in a Human Leukemic Cell Line (J_{6-1})"*

SOURCE: Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese No 3, Sep 79 pp 293-295

TEXT OF ENGLISH ABSTRACT: The chromosomes of J_{6-1} were treated with G- and C-banding techniques at the 36th and 48th generations. They were examined and counted under the light microscope, and the karyotype analysis was taken. In addition to a male karyotype demonstrated in this cell line, two marker chromosomes were found and named mar_1 and mar_2. The mar_1 is a dicentric chromosome, which comes from different origins, its frequency being 14 percent. The mar_2 is a translocated chromosome, which comes from t(4,11) (4pter→4q32::11q13→11pter), its frequency being about 90 percent.

*Received 27 November 1978.

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TITLE: "Maternally Inherited 'Sonless' Abnormal Sex-Ratio (SR) Condition in the Lady Beetle (Harmonia axyridis)"

SOURCE: Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese No 3, Sep 79 pp 296-304

ENGLISH ABSTRACT: The maternally inherited "sonless" abnormal sex-ratio (SR) condition of the lady beetle reported here was first discovered in Meitan of Guizhou Province (Tan, C.C., 1943), and later in Xian, 1964. The original female caught from the field at Meitan produced 13♀♀ and no males, and continued to produce only females up to the F_4 generation, totaling 247♀♀. Crosses had been made with nine of these females, one of which recovered to produce normal bisexual offspring.

The SR female collected in a Xian suburb produced 21♀♀ and 0♂. This SR strain ran through six generations producing only females with a total of 573♀♀. Among the 30 females that were raised to produce offspring, 5 were found to reproduce normal sex-ratio offspring.

[Continuation of YICHUAN XUEBAO No 3, Sep 79 pp 296-304]

[Professor TAN Jiazhen [6151 1367 2823] of Fudan University, as well as professors LIU Zudeng [0491 4371 3159] and SHENG Zujia [4141 4371 0857] provided counsel].

Received 11 December 1978.

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TITLE: "A Preliminary Study on Physiogenetic Control of Sexuality in Tilapia mossambica"

SOURCE: Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese No 3, Sep 79 pp 305-310

TEXT OF ENGLISH ABSTRACT: The study on sex control in T. mossambica has been carried out since 1976. The preliminary results of our study are briefly described as follows.

1. The fish treated with male hormone (MT_{30}) for 82 days at its larva stage developed into 97.0% males. On the other hand, the fish treated with female

[Continuation of YICHUAN XUEBAO No 3, Sep 79 pp 305-310]

hormone (BT_{30}) for 228 days developed into 94.9% females, with the result that the two sex hormones can exercise control of physiological sexuality of the fish in both directions.

2. On the basis of the above experiment, we further completed the genetic control of monosex females and obtained 98.5% (97.0-100%) daughters by ♀ x ♀. Through the approach of mating of ♂ x ♂, we have attained 73.4-74.5% sons, indicating the existence of YY males.

3. Fish treated with sex hormones had normal reproductive function. The use of sex hormones cannot alter genotype of sex, but only phenotype, i.e., physiological type. The genetic determination for sex in T. mossambica is of XX♀-XY♂ type.

4. In order to better guide the production of monosex populations, the genetic and physiological information on sex control in some fishes was analyzed, and the concept of a genetic-physiological type was introduced. The theory of "three line" combination for artificial control of sex in fishes is suggested.

[Received 8 January 1979.

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TITLE: "A Study on the Phenotypic Expression and Genetic Transmission of Dwarf-Gene Sources of Early Hsien Rice in China"*

SOURCE: Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese No 3, Sep 79 pp 311-321

TEXT OF ENGLISH ABSTRACT: This work was conducted at the college farm, Guangzhou, in 1976-1977. Four dwarfs of early Hsien rice (Oryza sativa subsp. hsien Ting), including Aijiaonante, Aizichan, Dijiaowujian (Dee-gee-woo-gen) and Guangchang mutant, were used for study. The main results obtained are summarized as follows:

1. Under the natural conditions of Guangzhou the major phenotypic expressions of the dwarfs have been described.

2. The dwarfism of four dwarfs is controlled by a recessive major gene identically. Furthermore, some modifying genes with positive or negative effects are involved in addition to the major gene. When the dwarfs cross with the same

[Continuation of YICHUAN XUEBAO No 3, Sep 79 pp 311-321]

long-culmed pollen parent Lengtsuima, the plant height of F_1 expresses incomplete dominance and the plant height of F_2 progenies exhibits bimodal distribution, yielding 3:1 ratio of tall to dwarf forms. Otherwise, some transgressive segregates occur.

3. The heritabilities (in a broad sense) of various characters influenced by the dwarfs are different. Their orders are thus arranged 200-grain weight (86.7%) > days of heading (80.3%) > percentage of sterility (73.0%) > width of flag leaf (70.0%) > length of panicle (64.1%) > panicle density (60.3%) > spikelets per main panicle (56.3%) > length of flag leaf (54.6%) > panicles per plant (27.1%).

4. According to the estimates of heritability, the expected genetic advance and combination productivity for five characters which directly or indirectly relate to yield are calculated. The genetic advances of various characters affected by the dwarfs are quite unalike. The magnitude of combination productivity among the dwarfs is Dijiaowujian > Aizichan > Aijiaonante > Guangchang mutant.

Problems concerning the classification of dwarfs, the primitive origin of semi-dwarf-genes and the prospect of the induced new dwarfs have also been discussed.

* Received 21 June 1978.

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TITLE: "Genetic Investigation on Pollen-Derived Plants in Wheat (Triticum aestivum)"

SOURCE: Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese No 3, Sep 79 pp 322-330

TEXT OF ENGLISH ABSTRACT: Genetic investigation on the pollen plants derived from F_1 hybrids of Triticum aestivum by anther culture was made and the following results were obtained.

1. About 90% doubled pollen plants were homozygous diploids. Wide diversity was observed among the pollen plants, showing the diverse recombinations of

[Continuation of YICHUAN XUEBAO No 3, Sep 79 pp 322-330]

their parents' genetical factors in F_1 pollen grains. The recessive characteristics, such as the white grain color, short culm, etc., were far more frequently exhibited in the pollen plant population than in the conventional F_2 population. It indicated that in pollen haploid breeding the efficiency of selection of these recessive characteristics would be increased.

2. No significant difference in vigor was observed between various generations of pollen plants which were planted in the same year. It showed that there was no vigor reduction in progenies of regenerated plants. Two unselected populations of pollen plants were compared with their parents on three characteristics with higher inheritabilities, i.e., plant height, ear length and 1000 seed weight. It was observed that pollen plant lines in the two populations, 6.4-12.8% and 2.2% respectively, showed transgressive inheritance for the three characteristics mentioned. It is suggested that certain selection pressure might occur in the anther culture process, which favors the induction of the genotypes with transgressive characteristics.

3. There were about 10% variants in regenerated plants of wheat. They might have resulted from gene mutation and/or chromosomal aberrations. Cytological investigations of ploidy status of variant regenerated plants were carried out. In anther culture in vitro multipolar mitosis, dicentric chromosome and chromosome fragments in somatic cells and synchronous division, unclear fusion in pollen grains, etc., were observed. In addition to the triploids (3x) and

[Continuation of YICHUAN XUEBAO No 3, Sep 79 pp 322-330]

haploids (4x) which usually constituted 90% of the regenerated plants, pentaploids (5x), octoploids (8x), typical nullisomics, aneuploids, partially fertile plants and morphologically abnormal plants were also obtained. It is suggested that anther culture may be used as an available tool to produce valuable aneuploids for chromosome and genome engineering.

Received 28 March 1979.

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TITLE: "Preliminary Study on the Local Soybean Varieties in Lower Yangtze and Huai Valleys. II. Genetic Variability of Quantitative Characters of Soybean Varieties"

SOURCE: Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese No 3, Sep 79 pp 331-338

TEXT OF ENGLISH ABSTRACT: The objectives of this paper are to study the genetic variability of 17 quantitative characters, including growth period, yield and mechanical harvesting, of local soybean varieties in the lower Yangtze and Huai valleys. The estimates of genotypic variance, genotypic coefficient of variation, heritability and expected genetic advance of these characters were calculated, in which the potentials and expected effects of selection from the natural population of these varieties were clearly indicated. From this study it is shown that the genetic resources of quantitative characters of these local varieties of soybeans are very abundant, that the simple selection is still one of the important methods in soybean breeding, and that to study the local varieties with the methods of quantitative genetics is of great importance both

[Continuation of YICHUAN XUEBAO No 4, Sep 79 pp 341-348]

in theory and practice in soybean breeding.

* GUO Zhengze [6753 2973 3419] took part in experiments.
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TITLE: "A Successful Test Tube Fertilization of Maize Ovules"*

SOURCE: Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese No 3, Sep 79 pp 339-342

TEXT OF ENGLISH ABSTRACT: Intact maize (Zea mays) ovaries were excised from unpollinated ears of field-grown plants and after cutting into 1/3 level were placed on modified White medium. Application of sterilized pollen to the naked ovules resulted in seed formation of 0.42% of all ovules. A total of 14 kernels were obtained in 9 sets of experiments. The plants of F_1 have genetic marker of purple color in the stalk and the ear's husks. The chromosome number of its root cells is $2n = 20$. All these proved that the plant is a hybrid originating from test tube fertilization of ovules.

* Received 14 November 1978.

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TITLE: "Embryonic Culture In Vitro and Observation on the Seedling Morphology and the Chromosomes of the Hybrids of Barley x Wheat"*

SOURCE: Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese No 3, Sep 79 pp 343-348

TEXT OF ENGLISH ABSTRACT: The intergeneric hybrid between barley and wheat has been obtained with the aid of culture of the young embryo in vitro 9-12 days. At first, only the roots differentiate from the hybrid young embryo and only a trace of the shoot appears. After adjusting the content of kinetin in the medium, the normal differentiation of the shoot tips is observed. There are 28 chromosomes for Tianjin 1 barley x Xiaoyan 58 wheat, most cells being in the root tip of the hybrid. This number fits in well with the expectant (7 + 21). But cells containing 21 or 49 (7 + 42) chromosomes are also found. The latter

[Continuation of YICHUAN XUEBAO No 3, Sep 79 pp 343-348]

contain 7 haploid chromosomes of barley and 42 diploid of wheat.

* Professor LIU Yitan [0491 3015 3544] revised the draft.
Received 20 December 1978.

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TITLE: "Genetic Distance of Quantitative Characters and Its Estimation"*

SOURCE: Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese No 3, Sep 79 pp 349-355

TEXT OF ENGLISH ABSTRACT: Genetic divergence of quantitative characters of crops was discussed in this article by using a method of multivariate analyses. Genetic distance was considered as a measure of the genetic divergence.

When two populations were characterized by n characters, an estimating formula of the genetic distance between them was given as,

$$D_{ij}^2 = \sum_{k=1}^{n'} (\tilde{g}_{ik} - \tilde{g}_{jk})^2,$$

where $\tilde{g}_{ik}$ is the k-th complex index value of n standardized genotypic values belonging to the i-th population, while

$$\tilde{g}_{ik} = \frac{1}{\sqrt{\lambda_k}} \sum_{h=1}^{n} l_{hk} g_{ih}$$

[Continuation of YICHUAN XUEBAO No 3, Sep 79 pp 349-355]

where g_{ih} is a standardized genotypic value of the h-th character belonging to the i-th population; λ_k, the k-th eigenvalue of the correlation matrix of the genotypic values ($\lambda_1 \geq \cdots \geq \lambda_n$); and l_{hk}, the h-th component of the k-th eigenvector.

The complex indice, $\tilde{g}_{ik}$ (k = 1,...,n), consisted of the first n' eigenvalues and their eigenvectors were referred to as the k-th standardized principal components. Evidently, the genetic distance of two populations is just the geometrical distance of the standardized principal components of the n characters belonging to these populations. Therefore, it can be considered as an important parameter of selecting parents for hybridization in crop breeding.

* Received 25 October 1978.

9717
CSO: 4009

AUTHOR: YE Daxian [5509 1129 1628]

ORG: None

TITLE: "A Large-Scale Experiment on the Enrichment of Chromite"

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA; GEOLOGICAL SCIENCE] in Chinese No 1, Jan 80 pp 1-10

TEXT OF ENGLISH ABSTRACT: A large-scale experiment on the enrichment of chromite was carried out in the course of trial-production of the casting stone from perchromate waste. The melts used for producing the casting stone are composed of perchromate waste, powder coal ash of power station and quartz sand. As a whole it is comparable with Yoder's olivine tholeiite in chemical composition. The total weight of melts used in the experiment is counted as 0.5-15 tons. Here some interesting phenomena were found. If the mixture of raw materials was unevenly mixed in the casting stone, some black nodes were presented which consisted of chromite (about 25%) and silicate glass (about 75%) and varied from 5 mm to 5 cm in sized. In these black nodes the content of Cr_2O_3 is always about 30 times as much as that of the casting stone which encloses the former. The observations and experiments show that the black

[Continuation of DIZHI KEXUE No 1, Jan 80 pp 1-10]

nodes were formed from the powder coal ash as a basal material. The FeO^*/Cr_2O_3 ratio in these black nodes is approximately a constant 1.10. The distribution coefficients of Cr_2O_3 and MgO in these nodes and coexisting casting stone K_D^{Cr} and K_D^{Mg} are 33 and 0.69 respectively. This shows that in the case of temporary coexistence of two liquid phases, i.e., the melts of black nodes and casting stone, under a non-equilibrium condition the content of a certain material presented in both phases must be controlled by the distribution law. As two liquid phases, one of which is rich in Al_2O_3 and FeO or Fe_2O_3, coexisted in the system of Cr_2O_3 of basaltic magma, Cr_2O_3 would be extracted by this liquid phase.

These experiments show that the assimilation of the argillaceous wall rocks by magnesian basic or ultrabasic magma is favorable to the enrichment of chromite. The author's experiments also indicate that when the content of $(FeO + Fe_2O_3)$ in raw materials is adjusted to approach that in powder coal ash, the black nodes cannot be formed even though the mixture of raw materials is unevenly mixed. In this case the chromite is dispersed in the casting stone completely. Therefore, the experimental results set up an explanation why ferriferous basic or ultrabasic magma is unfavorable to the formation of chromite deposits.

AUTHOR: PAN Yusheng [3382 5940 3932]

ORG: None

TITLE: "The Nappe Structure of Xizang and Its Geological Significance"

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA; GEOLOGICAL SCIENCE] in Chinese No 1, Jan 80 pp 11-18

TEXT OF ENGLISH ABSTRACT: Based upon materials collected by the author in recent years, various types of nappe structures are listed here with discussions of the manner and time of their formation. It is suggested that this kind of structure was produced due to the push-slipping of a series of fractured pieces that were formed along the upper part of the earth's crust during the continental collision. As a result of collision and compression of the continental blocks these structures are developing. The author considers the study of nappe structures to be of practical significance in reconstructing the geological environment of a certain region and furthermore it can also serve as a theoretical guide to the study of the mode of crustal movement, etc.

AUTHOR: WANG Sijing [3769 1835 2417]
ZHANG Juming [1728 5468 2494]

ORG: None

TITLE: "On the Block Mechanics for Stability Analysis of Rock Mass Structure"

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA; GEOLOGICAL SCIENCE] in Chinese No 1, Jan 80 pp 19-33

TEXT OF ENGLISH ABSTRACT: The problem being solved in this paper is the three-dimensional stability analysis of rock block, separated by two sets of geologic structural surfaces from rock mass and loaded by a force system without common point of the action of forces. Some theoretical aspects, such as the principle of the nodal equivalent forces and the principle of block stability in terms of virtual work, are discussed, and a mathematical method based upon the above-mentioned principles is developed to obtain a general solution for the stability of rock block for various possible modes of its instability. The analysis of a series of practical examples indicates the reliability of this theory and method, and the capability of the computer program.

AUTHOR: ZENG Qingtong [2582 1987 6265]

ORG: None

TITLE: "On the Regularity of En Echelon Arrangement of Ore Veins and Its Significance"

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA; GEOLOGICAL SCIENCE] in Chinese No 1, Jan 80 pp 34-42

TEXT OF ENGLISH ABSTRACT: This paper discusses the various types of en echelon ore veins and points out their characters and regularity. In addition, in connection with model experiments, the mechanism of formation of en echelon ore veins is analyzed. It is suggested that the generation and development of the ore veins under study could be attributed to shear strain followed by tension strain. Finally, from theoretical and practical viewpoints the author illustrates the regularity of en echelon ore veins.

AUTHOR: ZENG Rongshu [2582 2837 2885]
YE Danian [5509 1129 1628]

ORG: None

TITLE: "A Study of Structural-Optical Mineralogy--On Optical Anisotropy of Anhydrous Carbonates"

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA; GEOLOGICAL SCIENCE] in Chinese No 1, Jan 80 pp 43-49

TEXT OF ENGLISH ABSTRACT: The optical anisotropy of 44 anhydrous carbonates were discussed in this paper. These minerals belong to uniaxial and biaxial ($2V \leq 40^{0}$) crystals. Their refractivities, K, were calculated according to Gladstone-Dale's formula. The refractivity of a carbonate mineral can be resolved into two components, for ordinary ray (K_O) and K_e for extraordinary ray. If the mineral is biaxial, positive, $K_e = \frac{n_g - 1}{d}$, and $K_O = \frac{n_g + n_g - 2}{2d}$ and if the mineral is biaxial negative, $K_e = \frac{n_g - 1}{d}$ and $K_O = \frac{n_g + n_g - 2}{2d}$, where d is is density. Two new conceptions, the birefractivity (BR) and the optical anisotropic index (OAI), are proposed by the authors, $BR = K_O - K_e$, $OAI = K_e/K_O$. It will be convenient to discuss the relationship between optical anisotropy

[Continuation of DIZHI KEXUE No 1, Jan 80 pp 41-49]

and calculation of a carbonate mineral by using the two new conceptions. The conclusions may be drawn as follows:

1. Each component refractivities, K_o or K_e, of a complex carbonate can be directly calculated from that of the single carbonates. The results calculated are in good agreement with the experimental values. The largest deviation between them is only ±0.060, and average deviation only -0.001.
2. The BE of carbonates having the same structural type is approximately a constant, that is 0.060 for calcite-type, 0.039 for aragonite-type (but 0.051 for strontianite), -0.023 for vaterite-type (but -0.039 for vaterite) and so on.
3. The OAI of carbonates in which all the oblate CO_3 groups are not only parallel to each other, but also perpendicular to the unique axis, is equal to about 0.75. When the oblate CO_3 groups in the carbonates are not parallel to each other, but parallel to the unique axis, the OAI is equal to about 1.14. If there exist two different orientations of CO_3 groups in a carbonate mineral, its OAI is equal to about 0.90 instead of 0.75 or 1.14.
4. For the first transitional elements, the effect of the cation on refractivity depends upon their electronic configuration, especially on the number of d-electrons.
5. The authors infer that the $CeCO_3F$ having a negative sign for calcite will probably be found in nature, its two refractivity components K_o and K_e being 0.186 and 0.139 respectively.

AUTHOR: ZHAO Xiaolei [6392 7209 7378]

ORG.: Chengdu Geologic College

TITLE: "Grain-Size Distribution Characteristics and the Sedimentary Environment of Lower Tertiary 'Y' Beds from a Certain Area"

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA; GEOLOGICAL SCIENCE] in Chinese No 1, Jan 80 pp 50-64

TEXT OF ENGLISH ABSTRACT: The author suggests that in analyzing the grain size of clastical deposits by thin section method, the primary matrix must be taken into account and diagenetic matrix and authigenic clay should be removed. In terms of the probability cumulative frequency curves, the Lower Tertiary "Y" beds of northeast China may be divided into 10 types with different grain sizes reflecting such sedimentary environments as distributary channel, mouth bar, distributary mouth bar in wave zone, distant bar, offshore beach in wave zone. Moreover, the variables are also distinguished. In the author's opinion, only by combining the vertical grouping of probability cumulative curves with the sedimentary sequences and their primary structures can one effectively determine the sedimentary environment and subdivide sand bodies. Based on a certain model conceived, we can reasonably interpret the individual grain-size distribution. It is suggested that the "Y" beds resulted chiefly from the products of the

[Continuation of DIZHI KEXUE No 1, Jan 80 pp 50-64]

delta front to the wave zone of shallow sea. In the area studied there exist three mouth bars extending northward to the wave zone beach. The south part of the same area is marked by deep water turbidites which have developed as the result of a syngenetic faulting.

AUTHOR: CHEN Ruijun [7115 3843 0689]

ORG: None

TITLE: "Characteristics of Glauconites from some Regions and Their Significance in Analyzing the Facies Environment"

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA; GEOLOGICAL SCIENCE] in Chinese No 1, Jan 80 pp 65-74

TEXT OF ENGLISH ABSTRACT: This work mainly deals with the glauconites mineralogy collected from the fine-grained feldspar-sandstone of Cretaceous Yaojiazu Formation and of the Shasan member of Shahejie Formation in Songliao basin.

According to the external shape, the glauconites of several regions may be classified as follows: 1. spherulitic, 2. irregular granular, 3. pseudomorphs after other minerals, 4. irregular cement-like, 5. chamber colloid form and tongue-like. Moreover, the surface features of grains and character of grain size have also been examined. The internal microstructures of the crystals can be distinguished into two classes, microcrystalline, fine-flaky and radioted microcrystalline. It seems that the glauconites investigated here were mainly a sort of embryonic crystals or microcrystalline aggregates.

[Continuation of DIZHI KEXUE No 1, Jan 80 pp 65-75]

The variations in color, type of crystal structure, chemical composition, as well as the condition of formation of the investigated glauconite were also discussed. In general, glauconites are formed under a condition from weak oxidation to weak reduction in a medium of slight alkaline to meta-alkaline.

AUTHOR: WANG Zetiang [3769 0463 3068]

ORG: Sichuan Institute of Metallurgy and Geology

TITLE: "The Origin of 'Chert Breccia' in the Bottom of Qingbaikou Group in Yixian County, Hebei Province"

SOURCE: Beijing DIZHI KEXUE [SCIENTIA GEOLOGICA SINICA; GEOLOGICAL SCIENCE] in Chinese No 1, Jan 80 pp 76-82

TEXT OF ENGLISH ABSTRACT: The "chert breccia" under study refers to the breccia forming the basal part of the Xiamaling Formation of Qingbaikou Group and overlaying the Tieling Formation of Jixian Group of the Sinian suberathem in north China. As to its origin, various opinions so far expressed include sedimentary, glacial and chiefly karstic. Despite these differences, it is generally agreed that the base of the breccia marks a depositional gap, which forms the boundary between the Jixian and Qingbaikou Groups.

Investigations and observations of the "relic beds" from the brecciated strata, the breccia composition and the phenomenon of strain as well as on the so-called transitional horizon between brecciated strata and the underlying indicate that the chert breccia was formed due to gravity from the overlying strata in the

AUTHORS: [illegible] [illegible]
[illegible] [illegible]

ORG: [illegible] of [illegible] University; [illegible] of [illegible] University

TITLE: "Statical Spherosymmetrical [illegible] Solution of SU(2) Gauge Field--The [illegible], Uniqueness and the [illegible] Charge Current"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 3, May 79 pp 255-265

TEXT OF ENGLISH ABSTRACT: It is shown that the statical spherosymmetrical [illegible] solutions of SU(2) gauge field, which satisfy a physical boundary condition, must be [illegible]. Then from the [illegible] condition, we solve the [illegible] explicitly, hence showing the uniqueness analytically. By gauge transforming the Lagrangian by a local generator of [illegible]symmetry, we get a corresponding local charge current density which is both gauge invariant and conserved. The total values of either electric or magnetic charge are quantized, [illegible] the charge distributions in space are continuous and not restricted by [illegible]

[illegible] GAONENG WULI YU HEWULI No 3, May 79 pp 2[illegible]-2[illegible]]

[illegible] we discuss a mechanism of spontaneous symmetry breakdown. [illegible] magnetic line string, the ordered phase is surrounded [illegible] phase, the ordered phase repels electric fields, and electric [illegible] the ordered phase.

AUTHORS: [illegible] Wei [7612 0251]
[illegible] [1728 [illegible] 3902]
[illegible] [7120 4949 1350]
[illegible] [7618 2110 1131]
[illegible] [[illegible] 3185]

ORG: [illegible] of Shanghai Teacher's University; ZHANG, [illegible] and [illegible] all of [illegible] Teacher's College; [illegible] of Shanghai Meilong Middle School

TITLE: "A ψ-type Bag Model of Hadrons--The 'Rubber Bag' Model. Model II. The Mass Spectra of Hadrons"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 3, May 79 pp 264-271

TEXT OF ENGLISH ABSTRACT: The mass spectrum of the J/ψ meson family cannot be explained in the MIT bag model. Based on the theory of our Rubber Bag model of hadrons, the mass spectrum of the ordinary hadrons and that of the J/ψ family (ψ (3772) included) are calculated in a unified way in this paper. The results so obtained compare well to experimental data.

AUTHORS: GUAN [illegible] [7044 [illegible] 0589]
HE [illegible] [0149 [illegible] 1632]
[illegible] [7806 [illegible]]

ORG: GUAN of the [illegible] University of Science and Technology of China; HE of the Institute of Theoretical Physics, Chinese Academy of Sciences; [illegible] of the Institute of High Energy Physics, Chinese Academy of Sciences

TITLE: "On the Conjugate Field Quantity and the Definition of the [illegible] in the Conjugate Field Theory"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 3, May 79 pp 272-276

TEXT OF ENGLISH ABSTRACT: The definition of the conjugate field quantity in the conjugate field theory and the possible forms of the [illegible] are discussed. [illegible]

AUTHOR: ZHOU Guangzhao [0719 0342 [illegible]]
[illegible] [illegible]

ORG: ZHOU of the Institute of Theoretical Physics, Chinese Academy of Sciences

TITLE: "On the Dyson Equation and the Ward-Takahashi Identities of the Closed Time Path Green's Function"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 3, May 79 pp [illegible]

TEXT OF ENGLISH ABSTRACT: The Dyson equation satisfied by the closed time path Green's function of the order parameters is considered. The transport equation for the number density of the quasi-particles is written down in a general but simple form. Using the path integral formulation for the generating functional of closed-time-path Green's functions, the Ward-Takahashi identities are deduced.

AUTHOR: [illegible] [illegible 1525]
[illegible] [illegible]

ORG: [illegible] of the Institute of High Energy Physics, Chinese Academy of Sciences

TITLE: "[illegible] in the Production of [illegible]"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 3, May 79 pp [illegible]

TEXT OF ENGLISH ABSTRACT: [illegible] π^+ [illegible] π^- [illegible] have [illegible] of the previous work. [illegible] of the [illegible] [illegible].

AUTHOR: HAO [illegible] [7917 [illegible]]
ZHAO Weiqin [illegible]

ORG: Both of the Institute of High Energy Physics, Chinese Academy of Sciences

TITLE: "The Behavior of the Phase-Shift in the [illegible] Theory"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 3, May 79 pp [illegible]

TEXT OF ENGLISH ABSTRACT: The behavior of the phase-shift of the [illegible] theory and its relation with the phenomenological nuclear force $V = V_R + iV_I$ at high energy are explored. Two limits are obtained:

$$\mathrm{Re}\,\delta_l \xrightarrow[l\to\infty]{} -\frac{1}{2k}\int_0^\infty V_R(r)\,dr, \quad \mathrm{Im}\,\delta_l \xrightarrow[l\to\infty]{} \frac{1}{2k}\int_0^\infty V_I(r)\,dr.$$

It is found that the repulsive core with a sharp outer edge may induce a characteristic oscillation of $\mathrm{Re}\,\delta_l$, and $\mathrm{Im}\,\delta_l$ is sensitive to V_I. The conclusion is that the analysis of the phase-shift extending to higher energy is relevant in determining the repulsive core and the imaginary part of the nuclear force.

AUTHOR: [illegible]
LI [illegible]
[illegible]
[illegible]
[illegible]
ZHANG [illegible]
HE [illegible]

ORG: TENG, LI, [illegible], HE, YU and ZHANG all of the Institute of Atomic Energy, Chinese Academy of Sciences; HE of the Institute of High Energy Physics, Chinese Academy of Sciences

TITLE: "[illegible]"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 3, May 79 pp [illegible]

TEXT OF ENGLISH ABSTRACT: [illegible]

AUTHORS: [illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]

ORG: [illegible] the Institute of Modern Physics, Chinese Academy of Sciences

TITLE: "[illegible] of the Concept of the Depairing Probability to Explore Nuclear High Spin States"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 3, May 79 pp 348-356

TEXT OF ENGLISH ABSTRACT: In order to explore nuclear high spin states, a [illegible] concept of depairing probability has been suggested, which is based on the CAP and the RAL effects in the nuclear rotating system. We think that the depairing process might be gradual at the beginning, then dramatic, and finally gradual again. According to the concept of the depairing probability and the particle-rotor model, a formula for the spectrum of rotational energy has been obtained,

$$E_I = \frac{(\hat{I} - k P_I)^2}{2 J_0} + E_p P_I,$$

and the spectra for more than 50 nuclei have been calculated by using this

[Continuation of GAONENG WULI YU HEWULI No 3, May 79 pp 348-356]

formula. The calculated results are found to be in reasonable agreement with experimental data, and are able to reproduce the experimentally observed various back-bending phenomena on the plot of $\mathcal{J}_{eff} - \omega^2_{eff}$.

AUTHORS: J. H. HAMILTON
R. L. ROBINSON
A. V. RAMAYYA

ORG: HAMILTON of the Physics Department, Vanderbilt University; ROBINSON of Oak Ridge National Laboratory, Nashville, TN; RAMAYYA of Oak Ridge, TN

TITLE: "Discovery of Multiple, Collective Band Structures in Nuclei with A≈60-80"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 3, May 79 pp 155-181

TEXT OF ENGLISH ABSTRACT: Recent studies of levels in even-even ^{68,70,72}Ge, ^{70,72,74}Se, ^{74,76,78,80}Kr and ^{69}Ga and ^{74}Br have led to the discovery of a wide variety of different collective band structures. These include bands built on near spherical ground states and excited more well deformed shapes that may include triaxial shapes, rotation-aligned bands built on the same orbital $(g_{9/2})^2$ for both protons and neutrons, RAL negative parity bands with even and odd spins, and $\Delta I = 1$ γ-type vibrational band in even-even nuclei.

As recently as 1974, a survey of the energy level in the even-even Ge and Se isotopes (Ramayya) revealed little was known above a spin of 4^+. With the

[Excerpts from GAONENG WULI YU HEWULI No 3, May 79 pp 155-181]

[illegible] of the unusually low-lying excited 0^+ states in ^{70,72}Ge, first discovered in ^{72}Ge in 1958 at Vanderbilt (Hamilton), the theoretical treatment of [illegible] was limited primarily to [illegible] of the vibrational model. However, only recently there has been a surge of information on nuclei in this region that has revealed fascinating new features and also provided new insights into the excited 0^+ states. Particularly striking are the multiple, independent and highly collective band structures which we have discovered in our in-beam γ-ray spectroscopy studies following heavy-ion induced reactions. [illegible] of the theoretical understanding of the [illegible] of the collective [illegible] that are found in our studies of ^{68,70,72}Ge (Hamilton, Robinson, Ramayya), ^{70,72,74}Se (Ramayya, Hamilton, Ronningen, Piercey) and ^{74,76,78,80}Kr ([illegible], Robinson, [illegible]), as illustrated by the [illegible] different [illegible] found in our studies of the levels of ^{69}Ga, ^{74}Se, and ^{74}Br, are described in this paper. These multiple structures include the following: [illegible] bands built on near-spherical [illegible] shapes and [illegible] [illegible] bands with [illegible] rotation-aligned, RAL, bands built on [illegible] $(g_{9/2})^2$ [illegible] with the ground state band; [illegible] RAL [illegible] negative-parity bands [illegible] $g_{9/2}$ [illegible] $p_{3/2}$ [illegible];

[illegible] GAONENG WULI YU HEWULI No [illegible], May 79 pp [illegible]]

[illegible] Δ [illegible], which are best characterized as [illegible] [illegible] additional bands whose nature are presently not known.

[illegible] [1728 2417 2814] of the Institute of Modern Physics translated [illegible].

AUTHOR: WU Yong-shi [0702 0102 2313]

ORG: Institute of Theoretical Physics, Chinese Academy of Sciences

TITLE: "The Unitary Functional Formation of Yang-Mills Field Equations"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 3, May 79 pp 382-386

TEXT OF ENGLISH ABSTRACT: Starting from the integral formalism of gauge field, [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]-dimensional [illegible].

AUTHOR: TAN [illegible] [1223 0251 2398]

ORG: [illegible] Academy of Sciences

TITLE: "The Pulse Shape Discrimination Technique in a Proportional Counter"

SOURCE: [illegible] GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA [illegible]] in Chinese No 4, Jul 79 pp [illegible]

TEXT OF ENGLISH ABSTRACT: Based on the analysis of output current pulse shapes of [illegible], it appears that the discrimination between low-energy X-rays and [illegible] charged particles, even if both exist in the counter simultaneously (e.g., in the detection of transition radiation X-rays), could be performed if we select adequate counter filling gases or use a counter with a [illegible].

AUTHOR: CHEN [illegible] [7115 [illegible]]
[illegible] [7159 [illegible] 1327]
[illegible] [7[illegible]]

ORG: [illegible] University

TITLE: "[illegible] and the Representation Transformations of [illegible]"

SOURCE: [illegible] GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA [illegible]] in Chinese No 4, [illegible] 79 pp [illegible]

TEXT OF ENGLISH ABSTRACT: [illegible] (3), (27), [illegible].

AUTHOR: Shi Yilin [2457 5030 2516]
Hu Yin [0715 7299]

ORG: Dept of the Institute of Atomic Energy, Chinese Academy of Sciences

TITLE: "Investigation of Non-Linear Schrodinger Equation Soliton Solution"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 4, Jul 79 pp 418-431

TEXT OF ENGLISH ABSTRACT: Packet-like soliton solution of the non-linear Schrodinger's equation has been investigated. We found that a state of a free particle can possibly be described by this soliton solution, with the quantum property and the classical property of a particle as its limiting cases. A set of biorthogonal eigen-functions of non-hermitian operator, which can be used in the perturbation expansion, has been found. We discovered that the discrete eigenvalue node corresponds to the "classical" notion of a particle, and the continuous eigenvalue nodes correspond to the "quantum" notion. We suggested that the parameter u describing the state of a system can be used to identify whether the system is "quantum" or "classical."

AUTHOR: NI Guangjiong [0242 0342 3518]

ORG: Fudan University, Shanghai

TITLE: "The Levinson Theorem and Its Generalization in Relativistic Quantum Mechanics"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 4, Jul 79 pp 432-449

TEXT OF ENGLISH ABSTRACT: The Levinson Theorem in non-relativistic quantum mechanics is derived by Green function method which leads to the following expression:

$$n_l = \frac{1}{\pi}\left[\delta_l(0) - \delta_l(\infty)\right] - \frac{(-1)^l}{2}\sin^2\delta_l(0).$$

Then its generalization in Dirac equation is found as:

$$n_k^{(+)} - n_k^{(-)} = \frac{1}{\pi}\left[\delta_k(\pi) - \delta_k(\infty) + \delta_k(-\infty) - \delta_k(-\pi)\right]$$
$$- \frac{k}{|k|}\frac{(-1)^k}{2}\left[\sin^2\delta_k(\pi) + \sin^2\delta_k(-\pi)\right].$$

There are two expressions for Klein-Gordon equation:

$$n_l^{(+)} \pm n_l^{(-)} = \frac{1}{\pi}\left\{\delta_l(\pi) - \delta_l(\infty) \pm \left[\delta_l(-\pi) - \delta_l(-\infty)\right]\right\}$$

[Translation of GAONENG WULI YU HEWULI No 4, Jul 79 pp 442-449]

$$= \frac{(-1)^l}{2} [\sin^2 \delta_l(\infty) + \sin^2 \delta_l(-\infty)].$$

The application of these theorems and the range of their validity with relevant problems are discussed. An example of S state case in square well potential is treated for testing these formulas.

AUTHOR: PENG Huasheng [1756 7458 1108]
LI Zhongzhen [2621 1813 3791]
TIAN Deyuan [3944 1795 3293]
YU Chen [0060 1368]
LO Kaiyuan [5012 7030 0337]
HU Jiawei [5170 1367 0251]

ORG: PENG, LI, TIAN, YU and LO all of the Institute of Atomic Energy, Chinese Academy of Sciences; HU of the Institute of High Energy Physics, Chinese Academy of Sciences

TITLE: "Corona Discharge of Multi-Wire Proportional Chambers"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 4, Jul 79 pp 450-453

TEXT OF ENGLISH ABSTRACT: In this report, the stable corona discharge region of multi-wire proportional chamber (MWPC) has been measured. In this region we observed double peak phenomenon in Fe^{55} pulse amplitude distribution, and establish the fact that, once corona discharge region is present in MWPC, the spatial resolution power for light particles will be lost.

AUTHOR: CHEN Xiaoxiu [7115 1420 2540]
ZHANG Qingying [1728 1987 3602]

ORG: CHEN of the Laboratory of Geologic Bureau of Hunan Province; ZHANG of Hunan University

TITLE: "The Two-Body Spin-Orbit Coupling Interaction and the Energy Spectra of $f_{7/2}$ Shell Nuclei"*

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 4, Jul 79 pp 454-458

TEXT OF ENGLISH ABSTRACT: In this paper we use the central and two-body spin-orbit coupling forces as the residual interaction to calculate the energy spectra of $f_{7/2}$ shell nuclei, with the values of the exchanged parameters suitably regulated. The harmonic oscillator wave function is employed as the radial wave function. The consistency between the calculated energy levels of the nuclei and the experimental data is rather satisfactory. The results show that the effects of two-body spin-orbit coupling term in the residual interaction cannot be neglected.

* ZHANG Zhangzhu [1728 2222 3796], WEN Jiaozuo [2429 2403 0146] and HUANG Guoxiun [7806 0948 3196] took part in portions of the present study.

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TITLE: "A Statistical Description of Nuclear Reaction Processes"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 4, Jul 79 pp 459-468

TEXT OF ENGLISH ABSTRACT: Starting from the Neuman equation, the statistical description of nuclear reaction processes is achieved with coarse graining and the assumption of random distribution of matrix elements of residual interactions. The reaction cross-section obtained includes a part from precompound single and multistep processes and a part from compound reactions. The exciton model is discussed in comparison with the above results.

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TITLE: "On Nuclear Single-Particle Potentials (III) Single-Particle Energies Determined by the Nonhermitian Potential $u_{\alpha\beta} = M_{\alpha\beta}(\epsilon_\beta)$"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 4, Jul 79 pp 469-483

TEXT OF ENGLISH ABSTRACT: In this paper the following results are proved: although the single-particle (sp) potential $u_{\alpha\beta} = M_{\alpha\beta}(\epsilon_\beta)$ defined in terms of the mass operator $M_{\alpha\beta}(\omega)$ is nonhermitian, the discrete energy eigenvalues determined by the Schrodinger equation

$$h|\gamma\rangle = (t + u)|\gamma\rangle = \epsilon_\gamma|\gamma\rangle$$

are real; moreover, they satisfy exactly the following relation:

$$\epsilon_\gamma = \pm [E_{n\gamma}(N\pm1) - E_0(N)]$$

where $E_0(N)$ denotes the exact ground state energy of a closed-shell nucleus N, and $E_{n\gamma}(N\pm1)$ are exact energy eigenvalues of its neighboring N±1 nucleus.

Further, in order to determine whether the bound state energies obtained by any other sp potential may or may not satisfy the above relation, a simple method is suggested. It is shown that the amplitude renormalization of the sp Green function can also be calculated by means of this method.

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TITLE: "Effect of N* Production on High Energy Proton Scattering by Nucleus"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 4, Jul 79 pp 484-493

TEXT OF ENGLISH ABSTRACT: The variable separation method of Glauber multiple scattering theory is developed to include the N* production in the intermediate states and is used to calculate the inelastic scattering of proton by nucleus. Numerical results are compared with data on p-$^{12}C^*(4^+, 14.08)$ at 1 GeV and it implies that the effects of N* production to the high-energy proton-nucleus scattering are noticeable.

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TITLE: "The Sub-Body Correlation in the Chain-like Molecular Structure State"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 4, Jul 79 pp 494-500

TEXT OF ENGLISH ABSTRACT: From the microscopical many body theory, the formula of the projected variation method for three Well-Cluster shell model is given. The calculation has been made for the positive parity excited energy levels of ^{9}Be, and then a discussion is given of the ^{8}Be correlation and the ^{5}He correlation in the possible chain-like molecular structure.

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TITLE: "Master Equations for Coupling System"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 4, Jul 79 pp 501-510

TEXT OF ENGLISH ABSTRACT: In this paper the generalized coupling master equations are derived by means of the time-dependent projection operator. In first order Born approximation, the coupling master equations for any N-subsystems which only include diagonal elements are derived.

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TITLE: "Approximate Sequency for $U(t,t_0)$-Operator"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 4, Jul 79 pp 511-517

TEXT OF ENGLISH ABSTRACT: We give an approximate sequence for $U(t,t_0)$-operator. We prove the following theorems:
Theorem 1. If the norm $\|H(t)\|$ of $H(t)$ in equation (2.1) [$U(t',t_0) = 1 - i\int_{t_0}^{t'} H(t_1)U(t_1,t_0)dt_1$] is a Lebesgue integrable function with respect to t, then there is an approximate sequence $\{U_n\}$, such that for any state vector $|\phi\rangle$, $|\psi\rangle$, the sequence

$$\langle\phi|U_1|\psi\rangle, \langle\phi|U_2|\psi\rangle, \ldots\ldots, \langle\phi|U_n|\psi\rangle, \ldots\ldots$$

is uniformly convergent with respect to t.
Theorem 2. If in finite time interval the norm $\|H(t)\|$ of $H(t)$ in equation (2.1) is a Lebesgue integrable function, then equation (2.1) has a unique solution.

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TITLE: "Some Conjectures on the Mass Formula of Charged Leptons"

SOURCE: Beijing GAONENG WULI YU HEWULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS] in Chinese No 4, Jul 79 pp 518-522

TEXT OF ENGLISH ABSTRACT: In this note we propose that the electromagnetic self energy of lepton may be connected with quantum number n by $\frac{\delta m}{m} = \frac{1}{2\pi} n^{-b}$, in which b is a constant. We further propose that the cut-off value of momentum M is connected with gravitational constant K and fine structure constant α by $M = \frac{1}{\sqrt{K}}\alpha e^{-1-b}$. So we obtain the mass formula of charged leptons $m = \frac{1}{\sqrt{K}}\alpha \exp\left\{-\frac{3}{4} - b - \frac{1}{3\alpha}n^{-b}\right\}$. By using the masses of e^- and μ^- and the value of α as input, we get the calculated values of $K = (6.67231 \pm 0.00026) \times 10^{-8}\text{cm}^3\text{g}^{-1}\text{sec}^{-2}$ and $m_\tau = (1782.306 \pm 0.078)$ MeV, which agree very well with experimental values $K = (6.6720 \pm 0.0041 \times 10^{-8}\text{cm}^3\text{g}^{-1}\text{sec}^{-2}$ and $m_\tau = (1782^{+3}_{-4})$ MeV respectively. The mass of the fourth charged lepton predicted by the formula should be $m = (11725.47 \pm 0.51)$ MeV, which can be checked by experiments in the near future. We also discuss briefly the proposed formula and the obtained results.

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